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VOLUME 4, NUMBER 13JULY 1, 1971

SELECTED WATER RESOURCES ABSTRACTS is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the National Technical Information Service (NTIS), U.S. Department of Commerce. NTIS was established September 2, 1970, as a new primary operating unit under the Assistant Secretary of Commerce for Science and Technology to improve public access to the many products and services of the Department. Information services for Federal scientific and technical report literature previously provided by the Clearinghouse for Federal Scientific and Technical Information will now be provided by NTIS.

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WATER RESOURCES ABSTRACTS

'A Semimonthly Publication of the Water Resources Scientific Information Center, Office of Water Resources Research, U.S. Department of the Interior

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VOLUME 4, NUMBER 13JULY 1, 1971

W71-06456 -- W71-07058

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the Water Resources Thesaurus (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT PRESENTLY IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas.

Additional "centers of competence" have been established in cooperation with the Environmental Protection Agency, Water Quality Office. A directory of the Centers appears on inside back cover.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangements of this bulletin are welcome.

Water Resources Scientific Information Center Office of Water Resources Research U.S. Department of the Interior Washington, D. C. 20240

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02 WATER CYCLE

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03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

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06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

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09 MANPOWER, GRANTS, AND FACILITIES

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SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1A. Properties

THE PROBLEM OF FORMATIONS OF THE ION COMPOSITION AND MINERALIZATION OF FRESH WATER ICE UNDER VARIOUS CONDITIONS,

Cold Regions Research and Engineering Lab., Hanover, N.H.

For primary bibliographic entry see Field 02C. W71-06786

THE GENERATION OF ELECTROMOTIVE FORCES DURING THE FREEZING OF WATER, Columbia Univ., New York. Stanley Thompson Labs.

For primary bibliographic entry see Field 02C. W71-06925

METHODS FOR COLLECTION AND ANALY-SIS OF WATER SAMPLES FOR DISSOLVED MINERALS AND GASES,
Geological Survey, Washington, D.C.
Eugene Brown, M. W. Skougstad, and M. J.

Fishman

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC - \$2.00. Geological Survey Techniques of Water-Resources Investigations, Book 5, Chapter A1, 1970. 160 p, 14 fig, 3 tab.

Descriptors: *Water chemistry, *Water analysis, *Surface waters, *Groundwater, *Sampling, Methodology, Chemical analysis, Test procedures, Physical properties, Biological properties, Gases, Laboratory tests, On-site tests, Instrumentation, Dissolved solids.

Identifiers: *Water samples.

Methods used by the U.S. Geological Survey to collect, preserve, and analyze water samples for their content of dissolved minerals and gases are described. Among the topics discussed are selection of sampling sites, frequency of sampling, sampling equipment, sample preservation, laboratory equipment and instrumental techniques, accuracy and precision of analysis, and reporting of results. Seventy-six analytical procedures are given for determining 55 water properties. (Woodard-USGS) W71-07032

02. WATER CYCLE

2A. General

ALASKA-TEN YEAR COMPREHENSIVE PLAN FOR CLIMATOLOGIC AND HYDROLOGIC DATA.

For primary bibliographic entry see Field 06B. W71-06521

REPRESENTATION STORM OF PRECIPITATION FIELDS NEAR GROUND LEVEL,

California Univ., Davis. For primary bibliographic entry see Field 02B.

HEAT AND WATER REGIME OF SOME SIBERIAN REGIONS (Russian: Teplovoy i Vodnyy Rezhim Nekotorykh Rayonov Sibiri). Institute of Geography of Siberia and the Far East, Irkutsk (USSR).

Leningrad, 'Nauka', 1970. 113 p.

Descriptors: *Hydrologic aspects, *Heat balance, *Water balance, *Permafrost, Streamflow forecasting, Soil water, Ice-Water interfaces, Snow

surveys, Climatic data, Cold regions, Hydrologic data, Heat budget, Meteorological data, Soils, Hydrogeology, Geomorphology, Land reclamation. Identifiers: *Siberian regions, Hydrologic areas, Amur Oblast, Transbaykal, Irkutsk Oblast, Yakutsk ASSR, Seasonal fluctuations.

This is a seven-paper collection concerned with the climatic and hydrologic conditions of various regions of Siberia, for the purpose of calculating water and heat balances and dividing the area into regions according to character of runoff, moisture and heat supply. A brief assessment is made of rural hydrologic resources and of the results of studying hydrologic properties of snow cover on taiga landscapes. Of particular interest is the breakdown of vast areas of Siberia into regions according to streamflow, moisture content (soils, snow, groundwater), and heat supply. Subjects covered include a hydrologic description of the Transbaykal and the West Siberian Plain, calculation of heat and water balances in the Irkutsk Oblast, discussion of moisture types in the Amur Oblast, and properties of snow crystals in the central taiga of Western Siberia, study of orographic temperature inversion of air in Eastern Siberia, and ice formation in the southern Yakutsk ASSR. (See also W71-06708 thru W71-06713) (Josefson-USGS) W71-06707

ELEMENTAL AND HYDROLOGIC BUDGETS OF THE PANAMANIAN TROPICAL MOIST

Georgia Univ., Athens. Inst. of Ecology. J. T. McGinnis, and F. B. Golley.

In: Symposium on Sea-Level Canal Bioenvironmental Studies, Proceedings of the 19th Annual Meeting of American Institute of Biological Sciences, September 4-5, 1968, Ohio State Univer-sity, Columbus. Battelle Memorial Institute, Columbus Laboratories, Paper 14, April 21, 1969. 10 p, 2 fig, 2 tab, 22 ref.

Descriptors: *Rain forests, *Hydrologic cycle, Descriptors: *Rain torests, *Hydrologic cycle, *Ecology, *Food chains, Distribution patterns, Ions, Stable isotopes, Environmental effects, Productivity, Forests.

Identifiers: *Panama.

The tropical moist forest is characterized by a 3month dry period and occurs extensively in the east-central area of the Republic of Panama and portions of northwestern Colombia. It is the primary region of the interior inhabited by man. Eight one-eighth hectare plots were harvested and analyzed for 13 elements. Movement and storage characteristics and potential inputs to man for nine elemental compartments and seven hydrologic compartments are presented. This report describes some aspects of the movement and storage of stable elements through hydrologic and elemental functions of the tropical moist forest ecosystem.
(See also W71-06714) (Knapp-USGS) W71-06717

WATER RESEARCH.

Allen V Kneese and Stephen C Smith, editors. Papers presented at Seminars in Water Resources Research, sponsored by Resources for the future and the Western Resources Conference, at Colorado State University, July 1965. The John Hopkins Press, Baltimore, Md, 1966. 526 p.

Descriptors: *Water resources, *Water resources development, *Planning, *Water Resources Research Act, Water management (Applied),

These conference papers reflect years of research activity on problems of planning and managing water resources. The following developments over the past decade are highlighted in the papers: (1) clarification and far-reaching applications of economic concepts to water development and use; (2) emphasis on cross-disciplinary research; (3) use of high-speed electronic computers in water

management research; (4) emphasis on problems of recreation, water quality, and management of water-associated land used; (5) more research on political, administrative, and institutional factors; (6) the new role of federal agencies in water management research; and (7) the impact of the Water Resources Research Act of 1964. The papers are divided into areas including: (1) issues in theoretical economic analysis; (2) case studies of water management; (3) research on evaluation problems; (4) studies of water reallocation; (5) political and administrative studies; (6) research on hydrology and engineering; and (7) major research programs and needs. (See W71-06760 and W71-W71-06759

MAJOR RESEARCH **PROBLEMS** HYDROLOGY AND ENGINEERING.

William Ackermann.

In: Water Research, The Johns Hopkins Press, Baltimore, Maryland, p 495-501, 1966. 11 ref.

Descriptors: *Information retrieval, *Planning, *Water resources, Engineering geology, Dams Identifiers: *Water resources information, Urban

Sources of information on water resources problems in general are discussed, such as government publications and publications of activities of professional organizations like the American Geophysical Union. Research problems on hydrology and engineering cited as needing special attention are: river forecasting for water resource mangement, urban hydrology, the engineering and geology of dams, evaporation and transpiration, and prime water resources. (See also W71-06759) W71-06760

SOME OBSERVATIONS ON RAINFALL AND

RUNOFF, Norman H. Crawford.

In: Water Research The Johns Hopkins Press, Baltimore, Maryland, p 343-353, 1966. 10 fig.

Descriptors: *Runoff, *Runoff forecasting, *Rainfall-runoff relationships, Synthetic hydrology, Volumetric analysis. Identifiers: *Volume-time distribution.

This paper's purpose is to explain the complex processes involved in finding the volume and time distributuon of runoff; two factors basic to the study of the rainfall-runoff relationship. Illustrations of the role of various basic hydrologic processes are made using digital synthesis models (Standford Watershed Model IV). A schematic description of a watershed, presented in the first section, provides background for concepts and terms which follow. The second section discusses volume of runoff, and the third illustrates timing and runoff distribution. The conclusion comments on education in the response of watersheds to rainfall and on the application of synthesis methods of investigation to water resources studies in general. (See also W71-06759) W71-06761

THE YEARLY DISTRIBUTION OF RAINFALL INTENSITIES,

For primary bibliographic entry see Field 02B.

AVERAGE INTENSITY OF RAINFALL FOR USE IN THE RATIONAL FORMULA,

H. M. Gifft, and George E. Symons. Water Wastes Eng, Vol 5, No 12, p 44-45, Dec

Descriptors: *Hydraulics, *Storm runoff, *Rational formula, *Rainfall intensity. Identifiers: *Nomograms.

Field 02—WATER CYCLE

Group 2A-General

For convenience in design problems concerned with storm flow runoff where climatological data are not available, a monogram is provided and the map of iso intensities are applicable to the following formula, R-5.5 times H5 F (point 2)T (point 5) where: R-rainfall intensity (in./hr.), H5-rainfall intensity (in./hr.), nfall intensity (in./hr., 5-year frequency), F-—frequency of storms (years), and T—time of concentration (min.). W71-06966

AVERAGE ANTECEDENT TEMPERATURES AS A FACTOR IN PREDICTING RUNOFF FROM STORM RAINFALL,

Charles D. Hopkins, Jr., and Dale O. Hackett.

J Geophys Res, Vol 66, No 10, p 3313-3318, Oct

Descriptors: *Rainfall-runoff relationships, *New York, *New England, *Basins, *Storms, Rainfall, Storm runoff, Runoff forecasting. Identifiers: *Elevation-temperature relationships.

Rainfall-runoff relations in New England and New York have been shown to vary widely from basin to basin in a manner related to average basin latitudes and elevations. Station elevations and latitudes have been shown to be related to average tempera-tures. Average monthly and annual temperatures were computed for each basin sampled and average weekly basin temperatures estimated. These weekly temperatures were used to derive an index of average antecedent basin temperature based on a logarithmic recession. Two rainfall-runoff relationships were derived in which the index of antecedent basin precipitation, the index of average antecedent basin temperatures corresponding to the season of the storm, the average annual basin temperature, storm rainfall, and storm runoff were used. One of these relations applied to the spring and summer, the other to the fall and winter. Testing showed that a large part of the variation in the rainfall-runoff relationship had been removed. It was concluded that average basin temperatures can be used with profit in computing runoff in New England and New York. W71-06967

EVAPORATION AND CLIMATE - A STUDY IN

CAUSE AND EFFECT,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
For primary bibliographic entry see Field 02D.
W71-07034

GLACIER SURVEYS IN BRITISH COLUMBIA 1968: VOLUME 1 - ENGLISH SYSTEM; VOLUME 2 - METRIC SYSTEM,

Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch. For primary bibliographic entry see Field 02C. W71-07037

A HYDROLOGIC MODEL OF THE BEAR RIVER BASIN,

Utah Water Research Lab., Logan. For primary bibliographic entry see Field 04A. W71-07056

2B. Precipitation

TRITIUM LOSS FROM WATER EXPOSED TO THE ATMOSPHERE,

Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.

For primary bibliographic entry see Field 02K. W71-06456

ATMOSPHERIC TECHNETIUM-99, East Texas State Univ., Commerce. Dept. of Chemistry.

For primary bibliographic entry see Field 05A. W71-06457

PROBLEMS OF THROUGHFALL AND INTER-CEPTION ASSESSMENT UNDER TROPICAL

University Coll., Dar-es-Salaam (Tanzania). For primary bibliographic entry see Field 02I. W71-06474

ALASKA-TEN YEAR COMPREHENSIVE PLAN FOR CLIMATOLOGIC AND HYDROLOGIC

For primary bibliographic entry see Field 06B. W71-06521

THE REPRESENTATION OF STORM PRECIPITATION FIELDS NEAR GROUND LEVEL.

California Univ., Davis,

Cantornia Univ., Davis.

J. Amorocho, and A. Brandstetter.

Journal of Geophysical Research, Vol 72, No 4, p
1145-1164, February 15, 1967. 20 p, 12 fig, 3 tab,
12 ref. OWRR Project B-005-CAL (5).

Descriptors: *Precipitation (Atmospheric), *Distribution patterns, *Rain gages, *Statistical models, Mathematical models, Network design, Rainfall disposition, Mathematical studies, Statistics, Probability, Rainfall-runoff relationships. Identifiers: Rain gage networks.

The patterns of precipitation near the ground surface during a storm can be described by a filtered input field, which is amenable to mathematical statement and analysis. The filtered input field is generated by a process of smoothing of recording rain gage data, and it reveals the trends of the storm that are significant from the hydrological stand-point. For this purpose, techniques of curve and surface fitting based on the use of the threeparameter gamma distribution and low-order nonorthogonal polynomials were developed and applied to the analysis of precipitation events over a California watershed. These methods can be used for the establishment of criteria for precipitation network design and for the analysis of watersheds as nonlinear systems with distributed input fields. (Knapp-USGS)
W71-06658

HEAT AND WATER REGIME OF SOME SIBERIAN REGIONS (Russian: Teplovoy i Vod-nyy Rezhim Nekotorykh Rayonov Sibiri). Institute of Geography of Siberia and the Far East,

Irkutsk (USSR). For primary bibliographic entry see Field 02A. W71-06707

A HYDROLOGIC-CLIMATIC DESCRIPTION
OF THE WEST SIBERIAN PLAIN (Russian:
Gidrologo-Klimaticheskaya Kharakteristika
Zapadno-Sibirskoy Ravniny),
V.S. Mezentsev, and I. V. Karnatsevich.
In: Teplovoy i Vodnyy Rezhim Nekotorykh
Rayonov Sibiri, Leningrad, 'Nauka', p 23-42, 1970.
20 n. 25 fig. 10 tab. 32 ref.

20 p, 25 fig, 10 tab, 32 ref.

Descriptors: *Hydrologic data, *Heat balance, *Water balance, *Land reclamation, *Meteorolog-ical data, Moisture content, Moisture deficit, Seasonal, Precipitation (Atmospheric), Evapora-tion, Drainage, Irrigation, Runoff. Identifiers: *Western Siberia, Moisture surplus.

The natural heat and water balances and resources of Western Siberia are discussed in connection with required norms for hydrologic reclamation of the area. Results are presented in the form of tables and isogram maps showing heat and water balances along with various moisture and heat supply characteristics of the area. A detailed method for refining precipitation totals and for determining moisture content is accompanied by average long-term monthly, seasonal and annual precipitation maps and by maps depicting the annual runoff layer and total evaporation. Heat, precipitation and evaporation surpluses and deficiencies in various physico-geographic zones of the plain are calculated and serve as valid zonal specifications for hydrologic reclamations. Analysis and summariza-tion of the calculations have established that a moisture excess and heat deficiency in the northern part of Western Siberia call for drainage measures, while the southern part of the plain requires irrigation to counter a severe moisture shortage. (See also W71-06707) (Josefson-USGS) W71-06712

OBSERVATIONS OF RAIN AND HAIL GUSHES AFTER LIGHTNING,
Little (Arthur D.), Inc., Cambridge, Mass.
C. B. Moore, B. Vonnegut, E. A. Vrablik, and D. A. McCaig

Available from NTIS as AD-713 255, \$3.00 in paper copy, \$0.95 in microfiche. Paper, 10th Weather Radar Conference, Wash, D.C., April 22, 1963. 16 p, 26 ref.

Descriptors: *Thunderstorms, Correlation analysis, *Rainfall, *Precipitation intensity, Telemetry, Instrumentation, *Hail, Clouds, *Radar, Lightning, New Mexico.

Identifiers: Correlation techniques, Meteorological radar, Radar echo areas.

Observations of thunderstorms in New Mexico were made with a vertically-scanning, 3 cm radar on a mountain-top. Prior to a lightning stroke the radar echo was usually quite weak indicating precipitation echoes of 5 mm hr-1 or less. Following the lightning stroke it was observed that in the region of the cloud where the stroke took place the region of the cloud where the stroke took place the radar echo intensity rapidly increased and a gush of rain or hail fell nearby. In some cases after the lightning stroke there were regions in the cloud where the low radar reflectivity decreased instead of increased. These measurements confirm earlier radar observations, made by the authors at Grand Bahama Island B.W.I., which showed that lightning strokes are often followed by the detection of a rapidly-intensifying echo and then by a gush of rain at the ground. The increases and decreases in radar reflectivity in small volumes of the cloud following lightning suggest that the electric discharge is influencing the nature of particles in the cloud. W71-06798

RAIN-GAUGING PROGRAM TO PROVIDE GUIDE TO STORM SEWER DESIGN,

For primary bibliographic entry see Field 08B. W71-06964

THE YEARLY DISTRIBUTION OF RAINFALL INTENSITIES,

A. L. H. Gameson, and R. D. Quaife. Meteorol Mag, Vol 94, No 1115, p 173-180, 1965.

Descriptors: *Rain gages, *Rainfall-runoff relationships, *Hydrologic data.

Identifiers: *Storm sewage, *Great Britain.

Autographic rain-gages were installed at Bradford and Brighouse, Yorks., and Northampton during investigations of the flow and composition of storm sewage. The Northampton data were studied in detail in an attempt to compare the observed runoff distribution from an impermeable area of 115 acres with that calculated from the rainfall pattern. An equation used in the calculation of the probable yearly duration of rainfall intensities exceeding any particular value in inches per hour at a station with a given annual rainfall is presented. W71-06965

AVERAGE INTENSITY OF RAINFALL FOR USE IN THE RATIONAL FORMULA, For primary bibliographic entry see Field 02A W71-06966

CORRELATIONS OF STORM, MONTHLY AND SEASONAL PRECIPITATION, For primary bibliographic entry see Field 07A. W71-06968

Snow, Ice, and Frost-Group 2C

MESOSCALE SPATIAL VARIABILITY IN MID-WESTERN PRECIPITATION, F. A. Huff, and W. L. Shipp. J Appl Meteorol, Vol 7, No 5, p 886-891, Oct

Descriptors: *Rain gages, *Precipitation (Atmospheric), Illinois.
Identifiers: *Variability analysis.

Data from four dense rain gage networks operated for periods of 7 to 12 years on areas of 10 to 550 sq mi in Illinois were used to determine spatial relative variability of monthly and extended period precipitation of storms in continental climate typical of midwestern United States. The relation of storm variability to areal mean precipitation, storm duration, precipitation type, synoptic weather type, season, and size of sampling area was investigated W71-06969

AMOUNT OF PRECIPITATION AND SNOW ACCUMULATION AT VOSTOK STATION, Arkticheskii i Antarkticheskii Nauchno-Issledovatelskii Institut, Leningrad (USSR). For primary bibliographic entry see Field 02C W71-07015

2C. Snow, Ice, and Frost

FORMATION OF ANTARCTIC BOTTOM WATER IN THE WEDDELL SEA,
Coast Guard, Washington, D.C. Oceanographic

James M. Seabrooke, Gary L. Hufford, and Robert

Journal of Geophysical Research, Vol 76, No 9, p 2164-2178, March 20, 1971. 15 p, 15 fig, 1 tab, 19

Descriptors: *Sea water, *Salinity, *Water temperature, *Antarctic, Water circulation, Ocean currents, Ocean circulation, Oceanography. Identifiers: *Weddell Sea.

During the austral summers of 1968 and 1969, the USCGS Glacier penetrated the pack ice of the Weddell Sea to over 75 deg S. A total of 83 hydrographic stations were conducted during the two expenditions for analysis of temperature, salinity, sissolved oxygen, and nutrients. The data revealed a cold saline layer of water on the continental shelf below a depth of 200 meters in the southwestern Weddell Sea. This water mass is formed by alteration of coastal current water as it flows along and beneath the vast ice shelves in the southern Weddell Sea. The altered coastal current water then mixes with warm deep water along the continental slope in approximately 1:2 to form antarctic bottom water. The mixing ratio is confirmed by using core values of preformed phosphate and performed nitrate concentrations as conservative properties. Antarctic bottom water then flows out of the Weddell Sea between 50 and 15 deg W longitudes and 60 and 65 deg S latitudes. Bottom water flows into the Weddell Sea from the east near the Coats Land coast and is entrained into the antarctic bottom water flowing out. (Knapp-USGS) W71-06469

USE OF SIDE-LOOKING AIR-BORNE RADAR FOR SEA ICE IDENTIFICATION,

Coast Guard, Washington, D.C. Applied Sciences Div.

For primary bibliographic entry see Field 07B.

MEASURING ILLUMINATION WITHIN SNOW COVER WITH CADMIUM SULFIDE PHOTO RESISTORS,

Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station. James D. Bergen.

USDA Forest Service Research Note RM-181, 1970. 4 p, 3 fig, 6 ref.

Descriptors: *Photometry, *Snowpacks, *Solar radiation, *Telemetry, Instrumentation, Remote sensing, Snow surveys, Water equivalent, Albedo,

Identifiers: *Photometers.

Light-sensitive cadmium sulfide resistors can measure the downward flux of sunlight in the snow cover. When the variation of sensor response and the absorptivity of ice are considered together with the approximate distribution of energy in the solar spectrum, the variation of cell resistance may be used to estimate light attenuation. (Knapp-USGS) W71-06495

GRAVIMETRIC ICE THICKNESS DETERMINATION, SOUTH CASCADE GLACIER, WASHINGTON,

Geological Survey, Tacoma, Wash.

7 p, 3 fig, 3 ref.

Robert M. Krimmel. Northwest Science, Vol 44, No 3, p 147-153, 1970.

Descriptors: *Glaciers, *Gravity \u00e9tudies, *Surveys, Sounding, Washington, Gravimeters, Data collections, Density, Geophysics, Depth.
Identifiers: *Glacier surveys, *lce thickness

(Glaciers).

The vertical dimension of a glacier is the most difficult to measure directly, requiring a large number of expensive bore holes. Of the indirect methods, gravimetric seems most practical because of the large density contrast between ice and rock, known upper surface, and simple field procedure. A gravimetric analysis was carried out on the South Cascade Glacier. This is a small valley glacier (approximately 1 km wide and 3 km long) in the North Cascades of Washington. A Worden model no. 358 gravimeter was used. A bedrock base station was established, and all readings were tied to it in loops not exceeding three hours. Instrument drift was corrected by using this base as a standard and assuming a linear time relationship. A bedrock map based on crevasse patterns and surface velocities agrees tarry well with the gravimetric determina-tion. Combined with other estimations, gravity data can be very useful for determining the bedrock topography. (Knapp-USGS) W71-06508

SLAMTRANSPORTUNDERSOKELSER I NORSKE BRE-ELVER 1969 (SEDIMENT TRANSPORT STUDIES AT SELECTED GLACIER STREAMS IN NORWAY 1969) (Norwegian), Norwegian Water Resources and Electricity Board,

For primary bibliographic entry see Field 02J. W71-06694

DYNAMICS OF ICE-LENS FORMATION IN THE VALLEY OF THE ULAKHAN LEGLIYER RIVER, SOUTHERN YAKUTSK, ASSR (Russian: Dinamika Naledi v Doline R. Ulakhan Legliyer), V. R. Alekseyev, Yu. A. Gladkiy, and Z. G.

Ustinova.

In: Teplovoy i Vodnyy Rezhim Nekotorykh Rayonov Sibiria, Leningrad, 'Nauka', p 108-111, 1970. 4 p, 3 fig, 1 tab.

Descriptors: *Ice, *Discharge (Water), *Per-Descriptors: "Icc, "Discharge (water), "Permafrost, Surface waters, Frozen ground, Thawing, Rainfall intensity, Freezing, Groundwater, Base flow, Geomorphology, Seasonal, Permafrost. Identifiers: Yakutsk, ASSR.

The purpose of this paper is to examine ice-lens formation of subpermafrost waters in the valley of one of the Timpton River tributaries (Aldan shield). The ice-lens regimen is closely related to that of ice-forming sources. Three types of water participate in the ice-lens formation during the initial period (November and December): surface, superpermafrost and subpermafrost. Increase in the ice-lens area and thickness is greatest at this time, followed by an uneven development of ice-forming processes, i.e., intensive outflow of ice-forming waters (mainly subpermafrost) alternating with gradual decrease in source discharges. It is assumed that such rhythmic character is due to periodic freezing of the upper parts of outcropping unfrozen spots. Thawing of the ice layer, which begins in May and ends by early August, is most intense during periods of prolonged heavy rain. (See also W71-06707) (Josefson-USGS) W71-06708

OROGRAPHIC TEMPERATURE INVERSION OF AIR IN EASTERN SIBERIA AND ITS ROLE IN THE FORMATION OF PERENNIALLY FROZEN ROCKS. (Russian: Orograficheskaya Temperaturnaya Inversiya Vozhduka v Vostochnoy Sibiri i Yeye Rol' v Formirovanii Mnogoletnemeratukh Cornukh Pozok ziykh Gornykh Porod), V. R. Alekseyev, and G. N. Filosofova.

In: Teplovoy i Vodnyy Rezhim Nekotorykh Rayonov Sibiri, Leningrad, 'Nauka', p 102-107, 1970. 6 p, 5 fig, 4 tab.

Descriptors: *Air temperature, *Heat budget, *Thermal stratification, *Permafrost, Orography, Mountains, Geomorphology, Climatic data, Regional analysis, Air-earth interfaces, Seasonal fluctuations.

Identifiers: *Eastern Siberia, Yakutsk ASSR, Temperature inversion.

Data from regimen observations of orographic temperature inversion of a mountain-taiga landscape in Eastern Siberia have established that an inversion layer is formed almost the year-round in areas with a severely dissected plateau relief. The magnitude of inversion, its continuance and the thickness of the inversion layer are considerably greater in winter than during other periods of the year. Orographic temperature inversion of the air has an appreciable effect on the temperature regimen of rocks by lowering the level of heat exchange between the atmosphere-soil and the lithosphere. In the mountain-taiga regions of southeastern Siberia where the average heat exchange level approaches 0 deg. C, inversion leads to a formation of a layer of perennially frozen rocks in valleys and to an increase in their thickness in other regions. The presence of inversion and its high average annual values in Eastern Siberia call for corrections to meteorological observation data used in the calculation of seasonal thawing and freezing depths and in the thermal melioration of soils and rocks. Nu-merical inversion values should also be considered in any hydrologic regionalization. (See also W71-06707) (Josefson-USGS)

ANNOTATED BIBLIOGRAPHY ON SNOW AND ICE PROBLEMS,

Toronto Univ., Ontario, Canada. Dept. of Geog-

raphy. E. C. Relph, and S. B. Goodwillie. Natural Hazard Research Working Paper No 2, 1968. 13 p.

Descriptors: *Bibliographies, *Snow, *Ice, *Cities, *Snow removal, *Snow management, Melting, Snow cover, Hazards, Deicers, Equipment, Publications, Abstracts, Roads, Governments, Legal aspects, Social aspects, Warning systems. Identifiers: *Urban snow control.

This paper, a bibliography of 126 references on snow and ice problems, is one in a series on research in progress in the field of human adjustments to natural hazards. It is intended that these papers will be used as working documents by the group of scholars directly involved in hazard research as well as inform a larger circle of in-terested persons. The annotated bibliography lists publications including bibliographies and general studies, meteorological and climatic studies, studies of the impact of snowfalls, perception of the snow hazard, methods and costs of snow removal and ice control, and methods of snow removal. (Knapp-USGS) W71-06719

Field 02—WATER CYCLE

Group 2C—Snow, Ice, and Frost

THE INFLUENCE OF THE SOIL-FORMATION PROCESS ON THE COMPOSITION AND PROPERTIES OF THE DEPOSITS OF THE SEASONALLY FREEZING AND SEASONALLY THAWING LAYERS,

Cold Regions Research and Engineering Lab., Hanover, N.H.

Available from NTIS as AD-711 888, \$3.00 in paper copy, \$0.95 in microfiche. Translation of Shornik PO Merzlotovedenigu, Vol 5, No 7, p 87-97, 1967. CRREL Translation, 1970. 13 p.

Descriptors: *Freezing, *Thawing, *Thermal con-Descriptors: "Freezing, "Inawing, "Inermal conductivity, "Soil structure, Soil physical properties, Melting, Peat, Humus, Podzols, Moisture, Porosity, Identifiers: Organic materials, Decomposition, Deposits, USSR, Translations.

Data are cited which indicate the complex and multiform influence of the soil-forming process on the composition, properties, and structure of the seasonally freezing and seasonally thawing layers. W71-06784

AREAL VARIABILITY OF SNOW COVER CHARACTERISTICS,

Cold Regions Research and Engineering Lab., Hanover, N.H.

T. S. Trifonova.

Available from NTIS as AD-711 868, \$3.00 in paper copy, \$0.95 in microfiche. Translation of Trudy Glavnoy Geofizicheskey Obserostorii meni A I Voyeykooa, No 130, p 29-37. CRREL Transla-tion, 1970. 14 p.

Descriptors: *Snow cover, *Snow surveys, Density. Identifiers: Density, USSR, Translations

The article gives information on the variability in the height and density of snow cover, as well as on the accuracy of determining them in various physical-geographic regions. W71-06785

THE PROBLEM OF FORMATIONS OF THE ION COMPOSITION AND MINERALIZATION OF FRESH WATER ICE UNDER VARIOUS

CONDITIONS,
Cold Regions Research and Engineering Lab., Hanover, N.H.

I. M. Korenouskaya, and M. N. Tarasov. Available from NTIS as AD-711 873, \$3.00 in paper copy, \$0.95 in microfiche. Translation of Gidrokhimicheskiy Materialy, Hydrochemical Institute, Novocherkassk, Vol 47, p 77-87, 1968. CRREL Translation, 1970. 20 p.

Descriptors: *Ice, *Salinity, *Sea ice, *Freezing, Chlorides, Sulfates, Carbonates, Identifiers: USSR, Translations.

The research discussed pursued three main goals: Establishment of the nature of the dependence of the concentration of various ions (CI (-), SO4 (-2), HCO3 (-)) in the ice on their concentration in the initial solution; Establishment of the nature of the dependence of the concentration of various ions in the ice on the freezing temperature (or, the equivalent, the ice formation rate); and Discovery of whether the standard natural water solutions of the corresponding chemical composition are subject to these relations. W71-06786

COMPUTING THE FORMATION OF ICE IN-TERLAYERS IN FREEZING MOIST SOIL,

Cold Regions Research and Engineering Lab., Hanover, N.H.

For primary bibliographic entry see Field 08D. W71-06787

NOMOGRAMS FOR CALCULATING THE DEPTHS OF PERENNIAL FREEZING OF

ROCKS AND THERMAL CYCLES WITHIN THEM,

Cold Regions Research and Engineering Lab.,

Hanover, N.H.
For primary bibliographic entry see Field 08E.
W71-06789

PROBLEMS IN THE THEORY AND PRACTICE

OF ARTIFICIAL FREEZING OF SOIL, Cold Regions Research and Engineering Lab., Hanover, N.H. For primary bibliographic entry see Field 08D.

W71-06791

A STUDY OF THE HARDNESS OF ICE,

Cold Regions Research and Engineering Lab., Hanover, N.H. M. M. Khrushchov, and E. S. Berkovich

Available from NTIS as AD-716 457, \$3.00 in paper copy, \$0.95 in microfiche. Translation of: Izvcheniye tverdosti I'da, USSR Academy of Sciences Publishing House. CRREL Translation, Hanover, NH, 1970. 47 p, 25 ref.

Descriptors: *Ice, *Permafrost, *Cold weather construction, *Frozen soils, Snow, Compressability, Loads.

Identifiers: *Ice, Cold weather tests, Brittleness, USSR, Translations.

The present monograph is intended as a systematic presentation of data collected on the hardness of ice by the present authors and other investigators using various methods. It is believed that the monograph will be of general interest to scientists and engineering technical workers concerned in any way with ice, frozen soil, or snow at low temperatures. W71-06924

THE GENERATION OF ELECTROMOTIVE FORCES DURING THE FREEZING OF WATER, Columbia Univ., New York. Stanley Thompson

E. J. Murphy.

Available from NTIS as AD-716 726, \$3.00 in paper copy, \$0.95 in microfiche. Journal of Colloidal and Interface Science, Vol 32, No 1, p 1-11, Jan 1970. 31 ref.

Descriptors: *Freezing, *Water properties, *Elec-

Identifiers: Electrostatic fields, Molecular association, Electric potential, *Electromotive forces, *Hydrogen bonds.

The electromotive force generated by freezing degassed water in racuo is approximately the same as that generated in water containing dissolved air. The freezing potentials of dilute solutions were measured as a function of concentration. At the higher concentrations the potential is ice-negative, at lower concentrations ice-positive, with respect to the water. The freezing potential for all dilute solutions investigated (except NH4Cl) passes through zero at some concentration in the range 10 to -6 to 10 -5M. The ice-positive potentials are often as high as 120 volts, the ice-negative ones usually less than 30 volts. The ice-negative potentials are attributed to the entrapment of anions in excess in the ice. To account for the fact that a wide range of chemically different anions are entrapped in excess, the discrimination between ions in the entrapment process is attributed to the hydration shells of the ions. For cations the dipoles are predominantly directed outward, for anions inward leading to an activation energy for capture which is different for oppositely oriented hydration shells. W71-06925

THE INFLUENCE OF THE RADIATION FACTOR ON THE GROWING AND SHRINKING OF GLACIERS.

Army Engineer Waterways Experiment Station, Vicksburg, Miss.

F. Sauberer, and I. Dirmhirn.

Available from the National Technical Informat Service as AD-711 859, \$3.00 in paper copy, \$0 in microfiche. Waterways Experiment Stat Translation No 51-1, Vicksburg, Miss, 1951. 2

Descriptors: *Glaciers, *Melting, *Ablating*Solar radiation, Cloud cover, Albedo, Precip

Identifiers: Austria, Translations.

The different factors governing the radiat processes to which alpine glaciers are exposed; coming radiation; Outgoing radiation; The da-radiation balance; The effect of the variations the radiation factors. W71-06935

GEOMORPHOLOGY OF THE FILDES PENSULA ON KING GEORGE (WATERLO

USSR Arctic and Antarctic Scientific Reseatinst., Leningrad, Dept. of Geographical Sciences For primary bibliographic entry see Field 02J. W71-07013

RADAR SOUNDING OF ANTARCT GLACIERS IN THE SUMMER OF 1967/68, Arkticheskii i Antarkticheskii Nauchnoledovatelskii Institut, Leningrad (USSR). A. I. Kozlov, and B. A. Fedorov. Translated from Informatsionnyi Byulleten' Sovskoi Antarticheskoi Ekspeditsii, No 71, p 53, 19-Soviet Antarctic Expedition Information Bullet Vol 7, No 3, p 208-212, January 1971. 5 p, 4 fig.

Descriptors: *Sounding, *Glaciers, *Antarct *Radar, Remote sensing, Profiles, Mapping, I Geomorphology, Surveys, Identifiers: *Antarctica.

The radio physics group of the Thirteenth Sov Antarctic Expedition made radar soundings glaciers in the Molodezhnaya Station area between December 1967 and March 1968. Ice thickn was determined seismically (vertical sounding) ten points along the traverse. The surface under ing the ice is strongly dissected. The only except is the section from the coastline to the 35-km ma The bed has probably been smoothed here by glacier flowing to the sea. (Knapp-USGS) W71-07014

AMOUNT OF PRECIPITATION AND SNO ACCUMULATION AT VOSTOK STATION, Arkticheskii i Antarkticheskii Nauchno-l

ledovatelskii Institut, Leningrad (USSR).

V. G. Aver'yanov. Translated from Informatsionnyi Byulleten' Sov skoi Antarticheskoi Ekspeditsii, No 72, p 5, 19 Soviet Antarctic Expedition Information Bullet Vol 7, No 3, p 238-241, January 1971. 4 p, 2 fig tab, 3 ref.

Descriptors: *Snowfall, *Antarctic, Precipitat gages, Water equivalent, Precipitation (, mospheric), Water balance, Climatolo

Meteorology.
Identifiers: *Antarctica, *Vostok Station (Anta

Vostok Station, Antarctica, conducted simulta ous precipitation and snow accumulation obsertions between 1958 and 1961, and 1963 and 19 The precipitation sum measured by the Tret'yal gage in 9 years of observation was 342 mm or average of 38 mm/year. Snow accumulation of determined from systematic (once every 10 days once a month) measurements of the height of snow surface and the specific weight of the sno Snow cover depth was measured with a stake gr uated in centimeters at every meter of a ca stretched along a profile with sides each 20 m lo Total snow accumulation in 9 years was 225.7 to f water or an average of 25.1 mm/year. Thus, sum of precipitation exceeded accumulation

50%. This value (1/3) is probably the fraction of the total amount of measured precipitation due to snow blown into the gage. However, this does not take into account the evaporation of snow in summer. Most of the precipitation falls and accumulates during the cold period, from May to October. (Knapp-USGS) W71-07015

STUDY OF ICE MOVEMENT IN ENDERBY STUDY G. LAND IN 1967,

Arkticheskii Antarkticheskii Nauchno-Issledovatelskii Institut, Leningrad (USSR). M. P. Koshelev, and M. V. Aleksandrov

Translated from Informatsionnyi Byulleten' Sovetskoi Antarticheskoi Ekspeditsii, No 72, p 18, 1968. Soviet Antarctic Expedition Information Bulletin, Vol. 7, No 3, p 242-246, January 1971. 5 p, 2 fig, 3

Descriptors: *Glaciers, *Antarctic, *Surveys, *Movement, Regimen, Icebergs, Rheology, Velocity.

Identifiers: *Antarctica, *Enderby Land (Antarc-

The results are given of a study of a slow-moving section of ice, located between the Campbell and Hays outlet glaciers, Antarctica. The distance between these glaciers along the coastline is about 40 km, but the ice calves into the ocean across a section not exceeding 16 km in width because of the Thala Hills and other ice-free coastal areas. Ice velocity is small (1-4 m/year). At present, these speeds seem to be characteristic of areas of the Antarctic ice sheet blocked by oases. (Knapp-USGS) W71-07016

STUDY OF LAKES IN THE VICINITY OF MOLODEZHNAYA STATION,

Arkticheskii i Antarkticheskii Nauchno-Issledovatelskii Institut, Leningrad (USSR). For primary bibliographic entry see Field 02H. W71-07018

PROBLEM OF THE AMOUNT OF SNOW AC-CUMULATING IN CENTRAL ANTARCTICA, Arkticheskii i Antarkticheskii Nauchno-Iss-

Arkticheskii i Antarkticheskii Nauchno-iss-ledovatelskii Institut, Leningrad (USSR). V. G. Aver 'yanov. Translated from Informatsionnyi Byulleten' Sovet-skoi Antarticheskoi Ekspeditsii, No 73, p 5, 1969. Soviet Antarctic Expedition Information Bulletin, Vol 7, No 4, p 285-287, February 1971. 3 p, 1 tab,

Descriptors: *Snowfall, *Water equivalent, *Antarctic, *Precipitation gages, Precipitation (Atmospheric), Radioisotopes, Stable isotopes, Tracers, Snowpacks, Stratigraphy, Snow surveys. Identifiers: *Antarctica, *Vostok Station (Antarctica).

Correct determination of the amount of snow accumulating in Central Antarctica is extremely important for computing the mass gain of the Antarctic ice sheet. The most reliable accumulation data can be obtained by using snow surveys in conjunction with the stratigraphic method (supplemented by the determination of the age of snow with natural and artificial radioisotopes) and comparison of stratigraphic data (including the results of isotope analyses) with snow survey data. The average accumulation rate at Vostok Station is 25-30 mm/year, as determined by three different methods. Accumulation at Vostok Station can be compared with observations at other points in Central Antarctica where the precipitation and deposition conditions are practically the same. (Knapp-USGS) W71-07020

TEMPERATURE REGIME OF THE CONTINEN-TAL ICE SHEET IN ENDERBY LAND, V. Ya. Freyfel'd.

Translated from Informatsionnyi Byulleten' Sovetskoi Antarticheskoi Ekspeditsii, No 73, p 10, 1969. Soviet Antarctic Expedition Information Bulletin, Vol 7, No 4, p 287-290, February 1971. 4 p, 2 fig, 3

Descriptors: *Ice, *Temperature, *Antarctic, *Seasonal, *Variability, *Heat flow, Heat transfer, Heat balance, Heat budget, Climates, Melting,

Identifiers: *Antarctica, *Enderby Land (Antarc-

Observations on the temperature of the firm-ice layer of the continental ice sheet near the shore of Alasheyev Bight (Enderby Land) Antarctica, were carried out from April 10 through November 21, 1967. The measurements were made in a snow-filled hole approximately 4 km from the shore at an elevation of 280 m above sea level. The hole was made on the ice slope in a region of prevailing snow removal. In the immediate vicinity of the hole were areas that were bare of snow throughout the year. Snow depth at the mouth of the hole was small (from 11 to 35 cm, averaging 18 cm) throughout the observation period and had no significant effect on the temperature regime of the firn-ice layer. The active layer extends to a depth of 17 m in the upper part of the firn-ice cover. The depth of penetration of brief (1-6 days) temperature fluctuations with a systematic reversal of the sign of the gradient does not exceed 0.5-0.6 m. Prolonged intraseasonal temperature fluctuations penetrate to a depth of 2 m in the firn-ice layer. The depth of penetration of seasonal temperature fluctuations, corresponding to the cold and warm periods, reaches 12-13 m. The temperature of the firn-ice layer at the level of attenuation of annual fluctuations is -13 deg C. (Knapp-USGS) W71-07021

ACCUMULATION BETWEEN MOLODEZHNAYA STATION AND THE 200-KM MARK,

Arkticheskii Antarkticheskii Nauchno-Issledovatelskii Institut, Leningrad (USSR). S. S. Chikovskiy, N. A. Kornilov, and G. V. Konovalov

Translated from Informatsionnyi Byulleten' Sovet-skoi Antarticheskoi Ekspeditsii, No 73, p 62, 1969. Soviet Antarctic Expedition Information Bulletin, Vol 7, No 4, p 315-317, February 1971. 3 p, 1 fig, 3

Descriptors: *Snowfall, *Snowpacks, *Antarctica, *Snow surveys, Precipitation (Atmospheric), Regimen, Water balance, Climates, Weather, Temperature, Topography. Identifiers: *Antarctica.

In March 1964 a marked course was laid out in Antarctica from Molodezhnaya Station to the 200-km mark on the continental ice plateau, the markers serving also as snow stakes. Ice thickness was determined by radar, and glaciological observations, including measurements of the increment of snow and its density and determination of the direction and shape of sastrugi, made in a traverse to the 140-km mark in January-February 1968. The profile begins 8 km from the station at an elevation of about 300 m and runs due south. It curves a bit only at 69 deg 00'S to bypass a crevasse zone, and terminates at 60 deg 30'S at an elevation of 2100 Repeated observations made it possible to determine total snow accumulation between March 1964 and January 1968. W71-07022

TISING POSSIBILITY OF METEOROLOGICAL SATELLITE OBSERVA-TIONS FOR THE STUDY OF ANTARCTIC ICE, For primary bibliographic entry see Field 07B.

GLACIER SURVEY IN ALBERTA,

Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.

P. I. Campbell, I. A. Reid, and J. Shastal.

Copies available from Director, Inland Waters Branch, Dept. of Energy Mines and Resources, 588 Booth St., Ottawa, Ont, Canada. Canada Dept of Energy, Mines and Resources, Inland Waters Branch Report Series No 4, 1969. 15 p, 6 fig, 2 maps, 10 tab.

Descriptors: Surveys, *Glaciers, Regimen, Water storage. Data collections, Water resources, storage, Data collections, Water Hydrologic data, Topography. Identifiers: *Canada, *Alberta (Canada).

Because glaciers form part of Canada's water resources, some glaciers are surveyed on a continu-ing basis by the Water Survey of Canada in an effort to determine the extent and pattern of a glacier's influence on surface water runoff. This report summarizes the history of glacier surveys conducted in Canada by the Water Survey of Canada and describes present glacier survey practices. Tables of results for the period of record, some interpretation of these results and the most recent cier maps are also includded. (Knapp-USGS) W71-07033

GLACIER SURVEYS IN BRITISH COLUMBIA 1968: VOLUME 1 - ENGLISH SYSTEM; VOLUME 2 - METRIC SYSTEM,

Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.

I. A. Reid, and J. Shastal.

Copies available from Director, Inland Wates Br., Dept. of Energy, Mines and Resources, 588 Booth St., Ottawa, Canada, Canada, Inland Waters Branch Water Survey, Department of Energy, Mines and Resources, Report Series No 10, 1970. 26 p, 6 fig, 5 map, 31 tab. Published as 2 volumes, under separate covers.

Descriptors: *Glaciers, *Surveys, *Mapping. *Water resources development, *Aerial photog-*Mapping, raphy, Regime, Ablation, Melting, Water yield, Streamflow forecasting, Runoff, Runoff forecasting, Snow surveys. Identifiers: *Canada.

Because glaciers form part of Canada's water resources, some glaciers are surveyed on a continuing basis by the Water Survey of Canada in an effort to determine the extent and pattern of a glacier's influence on surface water runoff. This report summarizes the history of glacier surveys conducted in Canada by the Water Survey of Canada and describes present glacier survey practices. Tables of results for the period of record, some interpretation of these results and the most recent glacier maps are also included. During the summer of 1964, high-quality maps of five selected glaciers in British Columbia were prepared by stereoscopic terrestrial photogrammetric methods. In response to a Branch directive recommending greater use of the metric system, the Water Survey of Canada decided to change from the English to the Metric System in determination of biennial glacier variations. Because 1968 is the year of changeover, it was necessary to compile separate sets of maps using both the English and Metric Systems. (K-napp-USGS) W71-07037

SNOW FORECASTING FOR SOUTHEASTERN WISCONSIN.

Weather Service Office, Milwaukee, Wis. Rheinhart W. Harms.

Available from National Technical Information Service as COM-71-00119, \$3.00 in paper copy, \$0.95 in microfiche. National Oceanic and Atmospheric Administration Technical Memorandum NWSTM CR 38, November 1970. 13 p, 4 fig,

Descriptors: *Weather forecasting, *Snowfall, *Weather patterns, *Wisconsin, *Meteorology, Weather data, Data processing. Identifiers: *Snow forecasting.

Group 2C—Snow, Ice, and Frost

The accuracy of forecast snow accumulation for a particular area depends to a great extent upon the predictability of the track of the associated surface Low center. Of four basic track types which produce heavy snows in southeastern Wisconsin and the lower Great Lakes region, two can be readily recognized in their early stage of development and their deviations are less pronounced and less common. Models constructed of various types of storms indicate most precipitate their heaviest snow 120 to 140 nautical miles to the left of the track of the surface Low depending on the intensity of the storm and the precipitable water available along the storm track. Snow amounts in the heavy snow band correlate very well with the forecast precipitable water in advance of the storm along the storm track. (Knapp-USGS)

2D. Evaporation and Transpiration

ADSORPTION,

American Chemical Society, Washington, D.C. Joseph H. S. Haggin. Chemistry, Vol 44, No 4, p 6-9, April 1971. 4 p, 2 fig, 1 tab, 3 ref.

Descriptors: *Adsorption, *Gases, *Water vapor, Oceans, Molecular structure, Evaporation, Heat transfer, Hydrology, Diffusion, Surfaces, Surface tension.

Characteristics of the adsorption of gases to surfaces are described. If a surface is a good desiccant, adsorption of water vapor (drying of the wet material) must occur at a fantastic rate. In fact, for most purposes, adsorption is instantaneous. In most cases, drying of a material or evaporation of a liquid does not occur instantaneously but requires a relatively long time. For instance, the oceans don't dry up but remain at a fairly constant level. Why. Obviously something other than absorption must be involved. If only evaporation of water by desorption from the surface is involved, the maximum possible rate for pure water is about 235 grams per square cm per second. At this rate, the oceans would evaporate totally in a few days. The evaporation rate is controlled by the necessity for evaporated molecules to diffuse through a virtually stagnant layer of water vapor at the ocean's surface. Diffusion is a very slow process. A forest of trees evaporates much more water in a given time than an equal area of ocean surface. (Woodard-USGS) W71-06463

QUANTITATIVE SLOPE ASPECT DETER-

MINATION,
Agricultural Research Service, Beltsville, Md.
Hydrograph Lab.

For primary bibliographic entry see Field 07C.

CALCULATION OF CERTAIN ASPECTS OF THE HEAT AND WATER BALANCE FOR THE LAKE BAYKAL REGION (Russian: Raschet Nekotorykh Elementov Teplovogo i Vodnogo Balansov Diya Territorii Pribaykal'ya),

In: Teplovoy i Vodnyy Rezhim Nekotorykh Rayonov Sibiri, Leningrad, 'Nauka', p 43-57, 1970. 15 p, 8 fig, 4 tab, 20 ref.

Descriptors: *Heat balance, *Water balance, *Hydrologic data, *Meteorological data, Evaporation, Moisture content, Runoff, Precipitation (Atmospheric), Meteorology. Identifiers: Irkutsk Oblast.

Annual values for radiation balance, maximum possible evaporation, total evaporation and total moisture in the Irkutsk Oblast are examined on the basis of average long-term hydrometeorological indices. Particular attention is paid to the methodology and formulas used to determine these charac-

teristics. To calculate annual radiation balance values, an empirical formula is used which associates radiation balance with latitude and height of a point. Maximum possible evaporation, total moisture and total evaporation are computed according to the method of V.S. Mezentsev and are represented on accompanying maps in the form of isograms. Although approximate, these maps show the relationship between water and heat balances and the landscape conditions of the area. Further study in this direction can provide a basis for hydrologic regionalization of the Irkutsk Oblast. (See also W71-06707) (Josefson-USGS) W71-06711

A HYDROLOGIC-CLIMATIC DESCRIPTION
OF THE WEST SIBERIAN PLAIN (Russian:
Gidrologo-Klimaticheskaya
Zapadno-Sibirskoy Ravniny),
Kharakteristika

For primary bibliographic entry see Field 02B. W71-06712

MOVEMENT OF A MONOMOLECULAR FILM UNDER THE INFLUENCE OF A STEADY

Bureau of Reclamation, Denver, Colo.

L. A. Dayan.

L. A. Dayan.

Available from the National Technical Information
Service as PB-193 638T, \$3.00 in paper copy,
\$0.95 in microfiche. Translated from Akademii
Nauk Armianskoi SSR Izvestiia, Seriia Tekhnickeskikh Nauk, Vol 16, No 2-3, p 133-168, 1963.

Bureau of Reclamation Translation No 529, Denver, Dec 1964. 12 p.

Descriptors: *Monomolecular films, *Evaporation, *Winds, *Evaporation control, Alcohols, Boundry layers, Films.

Identifiers: Coriolis force, USSR, Hexadecanois, *Water conservation, Translations, *Evaporation retarding films.

Using standard equations of motion for the wind near the water and for the water near the lake surface, a formula was derived which was used to predict the velocity with which a monomolecular film is driven across a lake by a uniform wind of a given velocity. The differential equations of motion show that the velocity of movement of the monomolecular film is proportional to the wind velocity. However, the direction of motion of the film does not coincide with the wind direction, due to the effect of the Coriolis force. According to this theoretical derivation, the ratio of wind speed to film speed is equal to 32; whereas field observations show that this ratio is approximately equal to 20. This discre-pancy is attributed to the effect of various simplifying assumptions; e.g., the simplification of the equations of motion of the atmosphere, the assumption that the wind velocity is uniform, and the disregard for the effect of temperature differences between various points in the atmosphere. W71-06934

CONTINENTAL SABKHA IN ARAVA VALLEY BETWEEN DEAD SEA AND RED SEA: SIGNIFICANCE FOR ORIGIN OF EVAPORITES,

Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of

For primary bibliographic entry see Field 02J. W71-07024

EVAPORATION AND CLIMATE - A STUDY IN

CAUSE AND EFFECT,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch. F. I. Morton.

Canada, Inland Waters Branch, Department of Energy, Mines and Resources, Scientific Series No 4, 1968. 32 p , 13 fig, 22 ref.

Descriptors: *Evaporation, *Evapotranspiration, *Climatology, Water balance, Energy budget, Solar radiation, Soil moisture, Weather data, Meteorological data, Synoptic analysis, Evaporation pans, Hydrologic cycle.

Identifiers: *Ireland.

Evaporation from the soil and vegetation surfaces of a region depends on the availability of both water and energy. Water supply variations, by changing the amount of energy used for evaporation and the amount of heat and vapor convected. to the air, have substantial effects on the weather and hence on the energy available for evaporation. As the evaporation also has an effect on the water supply there is a problem of feedback and of distinguishing cause from effect. Consideration of energy and vapor transfers suggests that the regional evaporation is equal to the absorbed insolation less the evaporation from a small continuously moist surface, that is, to the absorbed insolation less the surface, that is, to the absorbed insolation less the potential evaporation, and that the potential evaporation can be calculated from several well known climatological techniques. Such a model permits the regional evaporation, a product of climatic, soil moisture and vegetative processes, to be estimated by use of evaporimeters and weather objects. servations. Differences between annual rainfall and annual runoff for river catchments in Ireland provide reasonable confirmation of the model when compared with predicted values. Analysis of records of evaporation pans and grass evaporimeters located in various parts of Ireland provides further verification and a deeper insight into the implications of the model. (Knapp-USGS) W71-07034

INSTRUMENTATION FOR STUDY OF ENER-

GY BUDGET OF RAWSON LAKE,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch. R. Chapil.

Canada Dept of Energy, Mines and Resources, Inland Waters Branch Technical Bulletin No 34, 1970. 15 p, 10 fig, 2 tab, 2 ref.

Descriptors: *Energy budget, *Meteorological data, *Lakes, Methodology, Instrumentation, Wind velocity, Air temperature, Water temperature, Humidity, Precipitation (Atmospheric), Evaporation, Solar radiation.

Identifiers: *Rawson Lake (Northwestern On-

This report describes equipment and procedures used and contains some graphical results obtained mainly during 1969 in the Rawson Lake study, a hydrological study of a small research basin in northwestern Ontario being carried out by several Government of Canada agencies working with University of Manitoba staff. The data collected are being used to establish climatic trends and variations; compare over-lake meteorological data with data from a Canada Department of Transport and-climatological station; determine regional radiation and energy budgets; and determine the effect of radiation and meteorological factors on lake productivity. (Woodard-USGS) W71-07035

A STUDY OF THE WATER BALANCE OF A NATURAL CATCHMENT USING A NEUTRON-SCATTERING MOISTURE METER,

Road Research Lab., Crowthorne (England).

Available from National Technical Information Service as PB-195 919, \$3.00 in paper copy, \$0.95 in microfiche. Ministry of Transport (Crowthorne, England), Road Research Laboratory Report LR 361, 1970. 12 p, 12 fig, 2 plate, 9 ref.

Descriptors: *Rainfall-runoff relationships, *Water balance, *Soil moisture, *Nuclear moisture meters, Evapotranspiration, Hydrologic budget, Surface-groundwater relationships, Flood forecasting, Ru-noff forecasting, Streamflow forecasting. Identifiers: *England.

The water balance of a natural catchment was studied by measuring change in soil moisture with a neutron-scattering moisture meter. The complete water balance was developed for both annual and monthly periods, using soil moisture and their

Streamflow and Runoff—Group 2E

change in magnitude with the season. The relation between the water balances of monthly duration and of individual storms throughout the year was found; the two water balances show similar seasonal characteristics. The evapotranspiration losses and changes in soil moisture throughout the year were considered from the point of view of flood flow estimation for a given catchment. (Knapp-USGS) W71-07042

GAMMA-RADIATION DETECTION OF WATER CONTENT IN TWO-DIMENSIONAL EVAPORA-TION PREVENTION EXPERIMENTS,

Iowa State Univ., Ames. Dept. of Agronomy. D. Kirkham, D. E. Rolston, and D. D. Fritton. In: Isotope and Radiation Techniques in Soil Physics and Irrigation Studies, Proceedings Symposium of International Atomic Energy Agency and the Food and Agriculture Organization of the United Nations, Istanbul, June 12-16, 1967: Vienna, IAEA--STI/PUB/158, Paper SM-94/21, p 3-16, 1967. 14 p, 6 fig, 9 ref. OWRR Project A-003-IA

Descriptors: *Evaporation control, *Hydraulic models, *Instrumentation, *Nuclear moisture meters, Gamma rays, Mulching, Evaporation. Identifiers: Evaporation models.

A gamma scintillation detector system was used to measure water contents in a two-dimensional soil model. The gamma apparatus was built into a lifting apparatus, which accommodates both vertical and horizontal 150 cm long soil columns and 150 by 35 cm two-dimensional soil models. Vertical movement of the gamma apparatus and horizontal movement of the model allow two-dimensional scanning. Water contents in two dimensions were determined for 2 cm simulated rainfall applications for the three treatments. When a subsurface-sand mulch was used, the mulch acted as a barrier to infiltration. Surface-sand mulches conserved more water than did the subsurface-sand mulch, but both the surface and the subsurface sand mulches conserved water as compared with no sand mulch layers. In addition, soil columns, 6.9 cm in diam. and 33 cm tall, were used to study the effectiveness of various thicknesses of surface-sand mulches in preventing evaporation. Thickness of sand mulches did not greatly influence the amount of water conserved if the sand layer was 1 cm or more thick. (Knapp-USGS) W71-07044

2E. Streamflow and Runoff

FINITE DIFFERENCE SOLUTION OF THE

FINITE DIFFERENCE SOLUTION OF THE FLOOD DIFFUSION EQUATION, Birmingham Univ. (England). Graduate School of Water Resources Technology; Birmingham Univ. (England). Dept. of Civil Engineering; and Essex

(England). Dept. of Civil Engineering, and Essex River Authority (England). I. E. Thomas, and P. R. Wormleaton. Journal of Hydrology, Vol 12, No 3, p 211-220, February 1971, 10 p, 4 fig, 7 ref.

Descriptors: *Floods, *Mathematical models, *Water level fluctuations, *Routing, Computer programs, Diffusion, Waves (Water), Theoretical analysis, Numerical analy graphs, Hydrograph analysis. Numerical analysis, Profiles, Hydro-Identifiers: Finite difference method.

Application of the flood wave diffusion equation to routing arbitrary input hydrographs involves step computations. The finite difference solutions of the basic equation may be obtained using iteration or matrix inversion techniques. The errors in the different procedures and the digital computational times involved are compared. The Hayami method, which utilizes the closed form solution of the equation for a constant input, is reviewed. Solution of the flood diffusion equation by finite difference methods give results of very high accuracy. The highest accuracies are obtained when the sets of al-

gebraic equations are solved by matrix inversion and the digital computer running time is simultaneously minimized. The maximum node spacing in a particular problem will be controlled by the extent of lateral inflows and in the locations of tributaries but the minimum spacing can then be decided on the basis of the error analysis. (Knapp-USGS) W71-06472

ANALYSIS OF EXPERIMENTS ON SECONDARY UNDULATIONS CAUSED BY SURGE WAVES IN TRAPEZOIDAL CHANNELS,

Societe Grenobloise d'Etude et d'Applications Hydrauliques (France).
For primary bibliographic entry see Field 08B.

THE LENGTHS OF STATIONARY WAVES ON FLOWING WATER,

Cambridge Univ. (England). Engineering Lab.; and Bataafse Internationale Petroleum Maatschappij N.V., The Hague (Netherlands). For primary bibliographic entry see Field 08B. W71-06479

TURBULENCE CHARACTERISTICS IN FREE SURFACE FLOWS OVER SMOOTH AND ROUGH BOUNDARIES,

State Univ. of New York, Buffalo; and Florida Univ., Gainesville. Dept. of Coastal and Oceanographic Engineering.

For primary bibliographic entry see Field 08B. W71-06480

VELOCITY DISTRIBUTIONS I CURVED OPEN-CHANNEL FLOWS, WIDE. IN

Imperial Coll. of Science and Technology, London (England). Dept. of Hydraulic Engineering; and Aleppo Univ. (Syria). Dept. of Engineering. For primary bibliographic entry see Field 08B.

CONCEPT OF CRITICAL SHEAR STRESS IN LOOSE BOUNDARY OPEN CHANNELS, West Virginia Inst. of Tech., Montgomery. Dept. of

Civil Engineering. For primary bibliographic entry see Field 08B. W71-06482

APPLICATIONS OF INFORMATION AND GRAPH THEORY TO MULTIVARIATE GEOMORPHOLOGICAL ANALYSES,

Colorado Univ., Boulder. Inst. of Arctic and Alpine Research; and Colorado Univ., Boulder. Dept. of Geological Science.

For primary bibliographic entry see Field 07C. W71-06486

WATER RESOURCES OF SPARTANBURG COUNTY, SOUTH CAROLINA,

Geological Survey, Columbia, S.C. W. M. Bloxham, George E. Siple, and T. Ray

Cummings South Carolina Water Resources Commission Report No 3, 1970. 112 p, 33 fig, 1 plate, 16 tab, 24

Descriptors: *Water resources, *Surface waters, *Groundwater, *South Carolina, *Hydrologic data, Data collections, Hydrogeology, Evaluation, Streamflow, Gaging stations, Flow rates, Discharge measurement, Runoff, Stream gages, Geology, Aquifers, Aquifer characteristics, Water yield, Water utilization, Water quality, Chemical analysis, Consumptive use, Meteorology, Hydrology,

Water resources development.
Identifiers: *Spartanburg County (S.C.).

The results of a 3-year study of the water resources of Spartanburg County, South Carolina are presented. About 40 percent of the average rainfall in Spartanburg County becomes streamflow. The

mean annual discharge of the drainage system is about 1,250 cfs or 1.5 cfs per square mile. However, streamflow is less than this amount more than 70 percent of the time, being sustained by ground-water inflow. Most streams in Spartanburg County contain water having excellent quality for domestic, industrial, and agricultural uses. The dissolved-solids content, is less than 100 mg/l at most locations. Groundwater occurs in the fractured locations. Groundwater occurs in the fractured hard rock and mantle of weathered rock throughout Spartanburg County. Well yields range from 1 to 250 gpm and average 20 gpm. The highest average yields of wells in Spartanburg County are obtained from wells drilled in the biotite gneiss and migmatite and the lowest average yields from wells in the quartz monzonite. Analyses of Glenn Springs showed the highest concentration of dissolved solids and the hardest groundwater in the county. (Woodard-USGS) W71-06487

LOW-FLOW CHARACTERISTICS OF IOWA STREAMS THROUGH 1966.

Geological Survey, Iowa City, Iowa. Albert J. Heinitz.

Iowa Natural Resources Council Bulletin No 10, 1970. 176 p, 6 fig, 2 plate, 2 tab, 4 ref.

Descriptors: *Streamflow, *Low flow, *Hydrologic data, *Water resources, *Iowa, Gaging stations, Flow rates, Data collections, Stream gages, Discharge measurement, Duration curves, Hydrographs, Flow characteristics, Average flow, Frequency analysis, Maps, Precipitation (Atmospheric), Runoff.

Identifiers: Streamflow characteristics, Historical

This report contains information on average discharge, low-flow magnitude and frequency, duration of flow, storage requirements, and regional draft-storage relations for interior streams in the State of Iowa. Data on the duration of flow are given for 113 gaging stations and on low-flow frequency for 77 gaging stations. Storage require-ments for selected draft rates are given for 65 gag-ing stations. Annual 7-day low flows having a recurrence interval of 2 years were computed for 431 low-flow partial-record stations. For some partialrecord stations, the 7-day low flow having a recurrence interval of 10 years is also given. These discharges were determined from correlations of periodic low-flow discharge measurements made at the partial-record sites and concurrent discharges at stream-gaging stations. Gaging-station records for the 26-year period 1941-66 were used to define a relationship in which average discharge is a funcprecipitation for the period 1931-60. The relation can be used to compute the average flow for any location on Iowa streams not significantly affected by regulation. (Woodard-USGS)
W71-06488

BLOCKING EFFECTS IN FLOW OVER OBSTA-CLES, Johns Hopkins Univ., Baltimore, Md. Dept. of

For primary bibliographic entry see Field 08B. W71-06499

STREAMFLOW IN THE UPPER SANTA CRUZ RIVER BASIN, SANTA CRUZ AND PIMA

COUNTIES, ARIZONA,
Geological Survey, Washington, D.C.
Alberto Condes de la Torre.

Available from SOD, Washington, DC 20402 -\$1.50. Geological Survey Water-Supply Paper 1939-A, 1970. 26 p, 14 fig, 6 plate, 8 tab, 13 ref.

Descriptors: *Streamflow, *Flow measurement, *Hydrologic data, *Arizona, Flooding, Peak discharge, Low flow, Gaging stations, Precipitation (Atmospheric), Data collections, Surface-groundwater relationships, Ephemeral streams, Hydroanalysis, Water resources, graphs, Frequency Statistical methods

Group 2E—Streamflow and Runoff

Identifiers: *Santa Cruz River basin (Ariz).

Streamflow records obtained in the upper Santa Cruz River basin of southern Arizona, United States, and northern Sonora, Mexico, have been analyzed to aid in the appraisal of the surface-water resources of the area. Records are available for 15 sites, and the period of record ranges from 60 yr for the gaging station on the Santa Cruz River at Tucson to 6 yr for Pantano Wash near Vail. The analysis provides information on flow duration, low-flow frequency and magnitude, flood-volume frequency and magnitude, and storage requirements to maintain selected draft rates. Flood-peak information has been projected on a regional basis from which estimates of flood magnitude and frequency may be made for any site in the basin. Most streams in the 3,503 sq-mi basin are ephemeral. Groundwater sustains low flows only at Santa Cruz River near Nogales, Sonoita Creek near Patagonia, and Pantano Wash near Vail. Elsewhere, flow occurs only in direct response to precipitation. The median number of days per year in which there is no flow ranges from 4 at Sonoita Creek near Patagonia to 335 at Rillito Creek near Tucson. The streamflow is extremely variable from year to year, and annual flows have a coefficient of variation close to or exceeding unity at most stations. Most floods result from high-intensity precipitation caused by thunderstorms during the period July to September. Occasionally, when snowfall at the lower altitudes is followed by rain, winter floods produce large volumes of flow. (Woodard-USGS)

AVAILABILITY OF WATER IN THE MISSIS-

SIPPI EMBAYMENT, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 02F. W71-06520

STOCHASTIC SIMULATION OF MONTHLY STREAMFLOW BY A MULTIPLE REGRESSION MODEL UTILIZING PRECIPITATION DATA,

Nevada Univ., Reno.

Jochanan Bonne.

Nevada Center for Water Resources Research Report, Reno, July 1970. 48 p, 12 fig, 4 tab, 13 ref. OWRR Project B-024-NEV (1).

*Streamflow, *Model processes, *Simulation analysis, Watersheds Descriptors: studies. *Stochastic analysis. *Regression (Basins). Precipitation (Atmospheric), Mathematical models, Equations, Computers, Computer programs, Evaluation, Synthetic hydrology, Streamflow forecasting.

Identifiers: Stochastic models.

A model for simulation of monthly streamflow series was developed by a multiple regression approach which includes both precipitation and flow. The variables in the regression function represent the previous month's flow, current precipitation, as independent variables, while the dependent variable is the current streamflow. A procedure is suggested for generating precipitation data which can be used in the multiple regression. The frequency distribution of the flow record in each month is determined by statistical analysis. These monthly distributions are later imposed on the model in order to reproduce data with the same statistical parameters and distributions. For each month the optimal combination of variables for the regression model is selected according to least variance, largest coefficient of determination, and the results of significance tests for the regression coefficients. Three watersheds with different physiographic characteristics were selected. Streamflows were simulated for each basin and the results agreed with the historic records of statistical parameters and frequency distribution. (Woodard-USGS) W71-06659

RANDOMLY FLUCTUATING FLOW IN A CHANNEL DUE TO RANDOMLY FLUCTUAT-ING PRESSURE GRADIENTS,

National Aeronautics and Space Administration, Cleveland, Ohio, Lewis Research Center. For primary bibliographic entry see Field 08B.

ANNUAL PEAK DISCHARGES FROM SMALL DRAINAGE AREAS IN MONTANA THROUGH

SEPTEMBER 1970, Geological Survey, Helena, Mont. M. V. Johnson, and R. J. Omang. Geological Survey Report, March 1971. 139 p, 1

Descriptors: *Floods, *Small watersheds, *Streamflow, *Peak discharge, *Montana, Hydrologic data, Gaging stations, Stream gages, Precipitation (Atmospheric), Runoff, Flooding, Frequency analysis, Flood forecasting, Data collections, Discharge measurement, Flood control.

A program to investigate the magnitude and frequency of floods from small drainage areas in Montana was begun July 1, 1955. Originally 45 crest-stage gaging stations were established. The program was expanded to 138 gaging stations in 1959, and to 202 gaging stations in 1963. About 200 stations were in operation from 1963 to 1967, and 185 were in operation in 1968, 1969, and part of 1970. This is the sixteenth annual report prepared to inform the cooperators, and other interested parties, of the status of the program. The report is primarily a tabulation, by water year, of the annual peak stage and discharge at each creststage gaging station. Also, it summarizes the activities and progress made during the 1970 water year. The ultimate objective is to obtain enough information on the magnitude and frequency of floods in various sizes and types of drainage basins to help design adequate highway drainage structures throughout the state. (Woodard-USGS) W71-06667

DRAINAGE AREA STATISTICS FOR THE CHESAPEAKE BAY FRESH-WATER CHESAPEAKE DRAINAGE BASIN,

Johns Hopkins Univ., Baltimore, Md., Chesapeake Bay Inst. R. C. Seitz.

Chesapeake Bay Institute Special Report 19, Reference 71-1, Johns Hopkins University, February 1971. 21 p, 1 map, 1 graph, 3 tab, 8 ref.

Descriptors: *Watersheds (Basins), *Streams, *Hydrologic data, *Bays, *Statistics, Gaging stations, Rivers, Tributaries, Runoff, Streamflow, Water yield.

Identifiers: *Drainage areas, *Chesapeake Bay in-

To sum the tributary inputs into Chesapeake Bay, the fresh-water drainage basin was divided up into 5-nautical mile long segment intervals beginning at the Bay entrance and river mouth locations and extending up to the limit of the tidal effects. Then additional segments, which were less than 5-nautical miles in length, were employed until either a dam or a gaging station was encountered, or until the entire drainage basin of the tributary head waters was defined. All areas in the tables are in square statute miles. The areas are set out in the tables according to rank. The main portion of the Chesapeake Bay is rank 1, a tributary entering the main Bay region is rank 2, etc. There are a total of 5 ranks. All accumulations are started anew with each rank. Fresh-water gaging stations are tabulated. Gaging stations which can be used for the segment under consideration are also given. Flow rates of drainage areas can be obtained at the gaging stations and then this factor can be applied to the segment involved to determine the fresh-water discharge for that drainage area. (Woodard-USGS) W71-06668

APPRAISAL OF THE WATER AND RELATED LAND RESOURCES OF OKLAHOMA.

For primary bibliographic entry see Field 06B.

SURFACE WATER SUPPLY OF THE UNITED STATES, 1961-65: PART 2. SOUTH ATLANTIC SLOPE AND EASTERN GULF OF MEXICO

Geological Survey, Washington, D.C. For primary bibliographic entry see Field 07C. W71-06674

THE INTERRELATIONSHIP BETWEEN WATER TEMPERATURE, BED CONFIGURATION, AND SEDIMENT CHARACTERISTICS IN THE MISSOURI RIVER,

Army Corps of Engineers, Omaha, Nebr. For primary bibliographic entry see Field 02J. W71-06681

EFFECTS OF URBAN DEVELOPMENT ON FLOODS IN NORTHERN VIRGINIA, Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 04C.

SUMMARY OF FLOODS IN THE UNITED STATES DURING 1965, Geological Survey, Washington, D.C.

J. O. Rostvedt.

Government Printing Office, Washington, DC 20402, 60 cents. Geological Survey Water-Supply Paper 1850-E, 1970. 110 p, 52 fig, 34 tab, 26 ref.

Descriptors: *Floods, *Flood damage, *Hydrologic data, *United States, *Rainfall-runoff relationships, Streamflow, Flow measurement, Data collections, Stream gages, Runoff, Peak discharge, Hydrographs, Flood plains, Reviews. Identifiers: *Flood summary (USA 1965).

This report describes the most outstanding floods in the United States during 1965. The four most amaging floods during the year, by order of decreasing magnitude, were in the South Platte River basin, Colorado (June), the upper Mississippi River basin (March-May), the Arkansas River basin in Colorado, Kansas, and New Mexico (June), and northwestern Missouri (July). The floods in the South Platte River basin were the most damaging in the history of the area. Floods in two separate periods in the upper Mississippi River basin were the most devastating in the history of an area which comprises parts of Minnesota, Wiscon-sin, Iowa, Illinois, and Missouri. Flood discharges in the Arkansas River basin in Colorado, Kansas, and New Mexico were many times greater than previous maximum discharges. Torrential rains on the Missouri River tributaries caused outstanding floods in a large area extending from the Iowa-Missouri State line on the north to the Blackwater River basin on the south and to the Grand River basin on the east. In addition to these floods, 23 others of lesser magnitude are included in this annual summary. (Woodard-USGS) W71-06693

WATER RESOURCES OF RACINE AND KENOSHA COUNTIES, SOUTHEASTERN WISCONSIN,

Geological Survey, Washington, D.C. Richard D. Hutchinson.

For sale by SOD, US Government Printing Office, Washington, DC 20402, \$1.25. Geological Survey Water-Supply Paper 1878, 1970. 63 p, 20 fig, 4 plate, 11 tab, 89 ref.

Descriptors: *Wisconsin, *Water resources, *Groundwater, *Aquifers, *Surface waters, Lake Descriptors: Michigan, Streams, Streamflow, Lakes, Water level fluctuations, Wetlands, Hydrologic budget, Water utilization, Groundwater recharge, Groundwater movement, Floods, Water quality, Urbanization, urveys, Water resources development. Identifiers: Inland lakes, Groundwater discharge.

Urbanization and changes in regional development in Racine and Kenosha Counties are increasing the need for water-resources information useful for planning and management. Lake Michigan assures the urbanized area in the eastern part of the two counties of a nearly inexhaustible water supply. In 1967 the cities of Racine and Kenosha pumped 32.6 mgd (million gallons per day) from the lake. Discharge from Racine and Kenosha Counties into Lake Michigan is low and has little effect on the lake. The Root and Pike Rivers and a number of smaller streams contribute a mean flow of about 125 cfs (cubic feet per second) to the lake. Groundwater, approximately 5 cfs, enters the lake as discharge from springs or as seeps. Thirty-five of the 43 lakes in the area are the visible parts of the groundwater table, and their stages fluctuate with changes in groundwater levels. The rest of the lakes are perched above the groundwater table. The sandstone aquifer, a major artesian reservoir underlying all of Racine and Kenosha Counties, is used as a water supply for industries, institutions, and three communities. Pumpage for these uses was about 3.3 mgd in 1967. The Niagara Dolomite is the principal shallow aquifer in the area. In 1967 pumpage from this aquifer for small community, domestic, stock, irrigation, and industrial uses was about 6.8 mgd. A water budget indicates that, of the 32 inches of precipitation that the area annually receives, about 7 inches runs off, and about 25 inches returns to the air as evapotranspiration. (Josefson-USGS) W71-06696

WATER WAVES GENERATED BY LAND-SLIDES.

Asian Inst. of Tech., Bangkok (Thailand). Edward Noda.

ASCE Proceedings, Journal of the Waterways, Harbors and Coastal Engineering Division, Vol 96, No WW 4, p 835-855, November 1970. 21 p, 12 fig, 2 tab, 9 ref, append. US Army Corps of Eng. Contract DACW-72-67-C-0002.

Descriptors: *Landslides, *Waves (Water), *Tsunamis, Earthquakes, Reservoir design, Coastal engineering, Shore protection, Model studies, Mathematical models, Hydraulic models. Identifiers: Landslide effects (Water waves).

The problem of water waves generated by landslides was studied by considering two distinct types of landslide; vertical and horizontal. Vertical landslides were studied by assuming that the landslide is modeled by a two-dimensional box falling vertically. A horizontal landslide is one which enters and moves through the water horizontally and was modeled analytically by a two-dimensional wall which moves into the fluid domain. Theoretical solutions were obtained assuming that the geometric and dynamic parameters of the problem are known. Graphs are presented for motion with constant velocity. For the vertical landslide problem, experiments were performed to verify this theory and the results compare very favorably in the region where linearized theory is valid. An approximate method is developed to find the amplitude of the largest wave in the nonlinear region by utilizing the solutions obtained from linear theory for vertical landslides. This approximate method was applied to the Lituya Bay, Alaska landslide of July 9, 1958 in order to estimate the largest wave. (Knapp-USGS) W71-06698

WATER TEMPERATURES OF CALIFORNIA STREAMS, NORTH COASTAL SUBREGION, Geological Survey, Menlo Park, Calif. For primary bibliographic entry see Field 07C. W71-06699

A REVIEW OF THE WORK OF THE JAROSLAV CERNI INSTITUTE FOR THE YEAR 1968, Institut za Vodoprivredu Jaroslav Cerni, Belgrade

(Yugoslavia).

Branislav Kujundzic

Available from NTIS as TT-69-5009/1, \$3.00 in paper copy, \$0.95 in microfiche. Transactions Institute for Development of Water Resources, 'Jaroslav Cerni,' Vol 14, No 45, p 45-69, 1969. 25

Descriptors: *Research and development, *Water resources development, Sedimentation, Floods, Hydraulics, River training, Regulation, Dams, Hydrogeology, Water chemistry, Land use, Conservation, Open channel flow.

Identifiers: *Water resources research, *Yu-

goslavia

The work of the Jaroslav Cerni Institute, Yugoslavia, 1968, is listed. Each entry consists of project name, cooperator, name of engineer in charge, nature of work, description of work, phase of work, results and publications. The subjects of studies include damsites, breakwaters, groundwater, delta projects, levees, flood damage, bridge sites, river regulation, sedimentation, dam failure, water conduits, arid-land hydrology, powerplants, salt balance, land improvement, open channel flow, stratified flow, structural engineering, economics, flood control, hydrogeology and waste disposal. (See also W71-06705 and W71-06706) (Knapp-W71-06704

STREAMFLOW AND HYDROLOGIC REGIONS OF THE TRANSBAYKAL (Russian: Rechnoy Stok i Gidrologicheskiye Rayony Zabaykal'ya), Institute of Geography of Siberia and the Far East,

Irkutsk (USSR).

G. V. Bachurin. In: Teplovoy i Vodnyy Rezhim Nekotorykh Rayonov Sibiri, 'Nauka', p 5-22, 1970. 18 p, 3 fig, 1

Descriptors: *Streamflow, *Hydrologic data, *Meteorological data, Runoff, Geomorphology, Precipitation (Atmospheric), Water balance, Water levels, Floods, Groundwater, Moisture content, Seasonal, Discharge (Water), Mathematical studies, Statistical methods.

Identifiers: *Transbaykal, Hydrologic regionaliza-

Because of the great variety of natural conditions in the Transbaykal, average annual maximum and minimum runoff values for adjacent river basins vary widely. Regionalization is particularly impor-tant here for facilitating an objective determination of various river regimen indices, water balance and streamflow owing to poor hydrologic coverage of the area. A critical analysis of present plans for a hydrologic regionalization of the Transbaykal is accompanied by a number of fundamental premises for a geographic-hydrologic regionalization. A basic criterion for hydrologic regionalization is a river water regimen expressed quantitatively and qualitatively in annual distribution of runoff, character of high waters, floods, low waters and in maximum water levels and discharges. Analysis of these and other river hydrologic data and an area study of a number of physico-geographic factors, especially relief, have led to the separation of the Transbaykal into 18 hydrologic regions. The new hydrologic regionalization is supported by quantitative descriptions of streamflow that take into consideration average annual runoff, maximum runoff of spring high water and summer-fall floods, minimum runoff in summer and fall and during the winter low-water period. (See also W71-06707) (Josefson-USGS) W71-06713

NORTH RACCOON RIVER FLOOD PLAIN IN-FORMATION, SAC COUNTY, IOWA. Corps of Engineers, Rock Island, Ill. For primary bibliographic entry see Field 04A.

W71-06721

CEDAR RIVER FLOOD PLAIN INFORMATION. BLACK HAWK COUNTY, IOWA. Corps of Engineers, Rock Island, Ill. For primary bibliographic entry see Field 04A. W71-06722

RUNOFF FROM COMBINED RURAL AND URBAN AREAS

For primary bibliographic entry see Field 05G. W71-06774

For primary bibliographic entry see Field 07C. W71-06962

EFFECT OF A COMMERCIAL CLEAR-CUTTING IN WEST VIRGINIA ON OVERLAND FLOW AND STORM RUNOFF, For primary bibliographic entry see Field 04C.

TIDES OFF-SHORE: TRANSITION FROM CALIFORNIA COASTAL TO DEEP-SEA

California Univ., San Diego, La Jolla. Inst. of Geophysics and Planetary Physics; and Scripps In-stitution of Oceanography, La Jolla, Calif. Walter Munk, Frank Snodgrass, and Mark

Available from National Technical Information Service as AD-716 130, \$3.00 in paper copy, \$0.95 in microfiche. Geophysical Fluid Dynamics, Vol 1, p 161-235, 1970. 75 p, 21 fig, 2 tab, 43 ref, 2 append. ONR Contract Nonr-2216 (12), Project No 083-502/8-25-69

Descriptors: *Tides, *California, *Water level fluctuations, *Mathematical models, *Currents (Water), Water circulation, Coasts, Data collections, Data processing, Waves (Water), Ocean cur-

Identifiers: *Tidal currents.

Tidal pressures and currents were measured with self-contained capsules dropped to the sea floor for one month at distances of 175,190, and 500 nautical miles from San Diego. These observations, together with a one-week bottom pressure record at intermediary distances, were analyzed for tidal components by cross-correlation with a noise-free reference time series. Tidal currents turn counterclockwise, and are polarized with maximum flow parallel to shore in the direction of tidal propagation at local high tide. The current amplitude is roughly 2 cm/sec for the semidiurnal component, 1 these diverse observations, the dispersion laws were modeled for all possible rotationally-gravitationally trapped waves against a straight coast with shelf. The mathematical model can account for the main features of the observed tidal heights, and gives relative amplitudes at the coast. Tidal currents are not well fitted by the model, and there are problems associated with the separation of barotropic and baroclinic modes, and with the benthic boundary layer. Coastal energy dissipation is small in the sea under investigation, but a 'capacitive' phase delay appears to be associated with Northern California harbors and inland waters. (Knapp-USGS)
W71-07043

2F. Groundwater

ON THE SOLUTION OF TRANSIENT FREE-SURFACE FLOW PROBLEMS IN POROUS MEDIA BY FINITE-DIFFERENCE METHODS, Oslo Univ. (Norway). Inst. of Geophysics. Marius Todsen.

Journal of Hydrology, Vol 12, No 3, p 177-210, February 1971. 34 p, 18 fig, 22 ref, 2 append.

Field 02—WATER CYCLE

Group 2F—Groundwater

Descriptors: *Groundwater movement, *Numerical analysis, *Drainage systems, *Mathematical studies, Theoretical analysis, Computers, Darcys law, Computer programs, Flow, Porous media, Hydraulic conductivity. Identifiers: *Finite difference method.

Numerical solutions are obtained for a few initialboundary-value problems in free-surface, saturated liquid flow through porous media. The exact differential equations governing the problems are approximated by finite-difference equations, and the resulting system of algebraic equations is solved by using an automatic digital computer. Only two-dimensional, homogeneous and isotropic flow models - including infiltration - are dealt with, but in principle there is little difficulty in extending the models to nonhomogeneous and anisotropic media.

Though also possible in principle, an extension to three dimensions demands a drastic increase in the necessary storage space of the computer. The question of computational stability of the dif-ference schemes adopted is considered. Good agreement with some results of other calculations is found for the two distinct models, one ditch drainage and one earth dam model. (Knapp-USGS) W71-06471

GROUNDWATER FLOW IN HETEROGENE-OUS, ANISOTROPIC FRACTURED MEDIA: A SIMPLE TWO-DIMENSIONAL ELECTRIC ANALOG.

Centre d'Hydrogeologie, Neuchatel, Switzerland.

Geological Institute.

Journal of Hydrology, Vol 12, No 3, p 255-261, February 1971. 7 p, 3 fig, 8 ref.

Descriptors: *Analog models, *Groundwater movement, *Anisotropy, *Fractures (Geology), *Aquifer characteristics, Permeability, Transmissivity, Model studies, Simulation analysis, Analog

computers, Water levels.
Identifiers: *Permeability tensor.

If two sets of fractures are orthogonal, the principal directions of the permeability tensor are always parallel to the normals of the two sets. Consequently, any desired orientation of the principal directions can be obtained by simple rotation of the two mutually orthogonal sets of fractures. Any permeability tensor can be simulated by two mutually orthogonal sets of fractures (or by three mutually orthogonal sets, in a three-dimensional space). Simulation of a heterogeneous, anisotropic permeability field may be accomplished by dividing the groundwater basin into regions with different permeability tensors. Each fracture geometry can permeability tensors. Each tracture geometry can be simulated by a very simple electric analog using conducting stripes painted on nonconducting paper. Consequently groundwater flow can be simulated in a heterogeneous, anisotropic permeability field by the means of a very simple electric analog. This electric analog permits study of the effect of irregularly developed and irregularly connected fractures on the potential field, on the permeability field, and on the follow systems. (Knapp-USGS) W71-06475

WATER RESOURCES OF SPARTANBURG COUNTY, SOUTH CAROLINA, Geological Survey, Columbia, S.C. For primary bibliographic entry see Field 02E. W71-06487

GROUNDWATER ASPECTS OF THE LOWER HENRYS FORK REGION, EASTERN IDAHO,

Geological Survey, Washington, D.C. E. G. Crosthwaite, M. J. Mundorff, and E. H. Walker.

Available from SOD, Washington, DC 20402 - \$0.70. Geological Survey Water-Supply Paper 1879-C, 1970. 22 p, 6 fig, 1 plate, 18 ref.

Descriptors: *Groundwater, *Withdrawal, *Water resources development, *Hydrogeology, *Idaho, Water wells, Aquifers, Aquifer characteristics, Water yield, Drawdown, Geology, Water utiliza-tion, Water table, Water levels, Streams, Surfacegroundwater relationships, Alluvium, Basalts, Water level fluctuations.

Identifiers: *Groundwater hydrology, *Henrys Fork region (Idaho), Volcanic rocks.

The lower Henrys Fork region in eastern Idaho includes the plains and low benches between Ashton and the junction of Henrys Fork and Snake River. The northwestern and western parts of the area are part of the Snake River basalt plain. The central part of the area is occupied by alluvial plains of the Snake, Teton, and Falls Rivers and of Henrys Fork. Snake, 1 eton, and Falls Rivers and of Henrys Fork. The alluvial deposits are underlain by basalt. The southeastern part of the area is a bench (Rexburg Bench), chiefly on silicic and basaltic volcanic rocks, which rises gradually to mountain peaks (Big Hole Mountains) southeast of the area. Total withdrawals of groundwater for irrigation in 1962, principally in the Rexburg Bench, were estimated. principally in the Rexburg Bench, were estimated to be 25,000 acre-feet. About 10,000 acre-feet was withdrawn for domestic, municipal, and stock supplies. These withdrawals caused no significant decline in the water table. In the Ashton area, surface-water irrigation has caused water to be perched in basalt above the silicic volcanic rocks, and much of this perched water contributes to streamflow. Some groundwater can be pumped from the basalt for irrigation and other uses. If groundwater were pumped for irrigation, the flow of Henrys Fork would be decreased by the amount of pumped water consumed by crops. Groundwater prospects for irrigation in the Falls River area are not encouraging. (Woodard-USGS) W71-06490

GEOLOGY AND WATER RESOURCES OF CLAY COUNTY, SOUTH DAKOTA, PART III - BASIC DATA,

South Dakota Geological Survey, Vermillion; and Geological Survey, Washington, D.C. Cleo M. Christensen, and Jerry C. Stephens. South Dakota Geological Survey Bulletin 19, 1970. 107 p, 3 fig, 3 tab.

Descriptors: *Water resources, *Groundwater, *Geology, *South Dakota, *Hydrologic data, Data collections, Water wells, Drill holes, Water yield, Water quality, Aquifers, Aquifer characteristics, Water level, Water table, Springs, Hydrogeology, Logging (Recording), Chemical analysis, Pumping, Specific capacity.
Identifiers: *Well data, *Test holes.

This report is a compilation of basic data gathered during a geological and hydrological investigation of groundwater in Clay County, South Dakota in 1963 and 1964. Purpose of the report is twofold: (1) to make basic geologic and hydrologic data available for future planning and study, and (2) as a supplement to related reports already published. The data include logs of wells and test holes, chemical analyses of water from selected wells, records for springs, and maps showing locations of investigations. Each well record also includes owner or use, year completed, depth of well, casing diameter, land-surface altitude, principal aquifer, type of pump, use, water level, date of measurement or visit, specific conductance of water, hardness, and remarks. (Woodard-USGS) W71-06501

GEOHYDROLOGY OF THE SHALLOW AQUIFERS OF BATON ROUGE, LOUISIANA, Louisiana State Univ., Baton Rouge. Water Resources Research Inst. Charles G. Smith, Jr.

Louisiana Water Resources Research Institute Bulletin GT-4, Louisiana State University, October 1969. 31 p, 14 fig, 1 tab, 19 ref. OWRR Projects A-004-LA (4) and B-002-LA (2).

Descriptors: *Hydrogeology, *Aquifers, *Groundwater, *Saline water intrusion, *Louisiana, Water pollution sources, Aquifer characteristics, Pumping, Water yield, Water quality, Hydrologic data, Hydrology, Water wells, Chemical analysis, Chlorides, Industrial water, Drawdown, Groundwater recharge. Identifiers: *Baton Rouge (La).

The geohydrology of the 10 major aquifers in the The geohydrology of the 10 major aquiters in the Baton Rouge, Louisiana area was studied in order to determine the threat of salt-water intrusion to industrial water supplies. The '400-ft' and '600-ft' sands furnish 22% of the annual groundwater withdrawal from the aquifers. Salt water has been advancing northward toward the industrial center in the '600-ft' sand as a result of hydraulic gradients. in the 600-ft sand as a result of hydraulic gradients created by industrial groundwater pumpage. Three miles south of this area, the Baton Rouge fault obstructs the flow of water from the south side of the fault. Apparently the salt water intruding the industrial wells was trapped in the '600-ft' sand north of trial wells was trapped in the '600-ft' sand north of the fault and an unknown distance west of the Mississippi River. The '400-600 ft' aquifer complex was not affected to any extent by the Denham Springs fault immediately north of the city. Local pinchouts of the two aquifers obstruct flow north and southwest of the industrial area. The Mississippi River indirectly replenishes the '400-600 ft' complex west of the river through the 'University Sand'. Remayal of the salt water north of the fault. Sand.' Removal of the salt water north of the fault will result in natural replenishment with fresh water. (Woodard-USGS)

METHODS AND APPLICATIONS OF ELECTRI-CAL SIMULATION IN GROUNDWATER STU-DIES IN THE LOWER ARKANSAS AND VER-DIGRIS RIVER VALLEYS, ARKANSAS AND OKLAHOMA,

Geological Survey, Washington, D.C. M. S. Bedinger, J. E. Reed, C. J. Wells, and B. F.

Available from SOD, Washington, DC 20402, \$1.00. Geological Survey, Water-Supply Paper 1971, 1970. 71 p, 36 fig, 4 plate, 3 tab, 27 ref.

Descriptors: *Analog models, *Surface-ground-water relationship, *Alluvial aquifers, *Arkansas, *Oklahoma, Groundwater, Rivers, Valleys, River training, Hydrogeology, Water levels, Pumping, Water level fluctuations, Model studies, Methodology, Reservoirs, Streamflow, Aquifer characteristics, Evaluation.

Identifiers: *Arkansas River Valley, *Verdigris River Valley River Valley.

The Arkansas River Multiple-Purpose Plan will provide year-round navigation on the Arkansas River from near its mouth to Muskogee, Okla., and on the Verdigris River from Muskogee, Okla., and on the Verdigris River from Muskogee to Catoosa, Okla. The altered regimen in the Arkansas and Verdigris Rivers will affect groundwater conditions in the adjacent alluvial aquifers. Analysis and projections of groundwater conditions were made by use of electrical analog models. These models use the analogy between the flow of electricity in a resistance-capacitance circuit an the flow of a liquid in a porous and permeable medium. A test of the validity of the analog to perform as the aquifer would, within the range of historic forces was verified. The verification process consisted of simulating the action of historic forces which had acted tating the action of instoller forces which had acted upon the aquifer and of duplicating the aquifer response with the analog. Dams on the Arkansas and Verdigris Rivers will impose a direct change in water levels in the aquifers adjacent to the rivers. This change will be attenuated by the resultant change in accretion to the aquifer. The analogs of aquifers in the valleys were used to determine the change in groundwater level from preconstruction to postconstruction conditions. (Woodard-USGS) W71-06507

POTENTIAL DEVELOPMENT AND RECHARGE OF GROUNDWATER IN MILL CREEK VALLEY, BUTLER AND HAMILTON COUNTIES, OHIO, BASED ON ANALOG MODEL ANALYSIS, Geological Survey, World Geological Survey, Washington, D.C.

Richard E. Fidler

Available from SOD, Washington DC 20402, \$1.00. Geological Survey Water-Supply Paper 1893, 1970. 37 p, 12 fig, 4 plate, 2 tab, 14 ref.

Descriptors: *Withdrawal, *Water level fluctua-Descriptors: "Withdrawal, "Water level fluctua-tions, "Prawdown, "Groundwater recharge, "Analog models, Ohio, Hydrogeology, Water wells, Aquifers, Aquifer characteristics, Precipitation (Atmospheric), Water utilization, Artificial recharge, Water yield, Water table, Water levels, Model studies, Water resources development, Water supply. Water supply. Identifiers: *Groundwater development.

Mill Creek valley is part of the greater Cincinnati industrial area in southwestern Ohio. In 1964, nearly 30 percent of the water supply in the study area of about 27 square miles was obtained from wells in the glacial-outwash aquifer underlying the valley. Groundwater demand has increased steadily since the late 1800's, and excessive pumpage during the years of World War II caused water levels to decline to critical levels. Natural recharge to the aquifer, from precipitation, is about 8.5 mgd. In 1964, the total water use was about 30 mgd, of which 8.1 mgd was obtained from wells in Mill Creek valley, and the remainder was imported from outside the basin. By the year 2000 groundwater pumpage is expected to exceed 25 mgd. Three pumpage is expected to exceed 25 mgd. Three hypothetical pumping plans were developed by projecting past pumpage data to the years 1980 and 2000. Various combinations of injection wells were tested on the model under different hypothetical conditions of pumpage. Based on analog model analysis, from three to eight injection wells, with an approximate input of 2 mgd each, would reverse the trend in declining groundwater levels and pro-vide adequate water to meet anticipated demands. Woodard-USGS) W71-06509

HYDROLOGY OF LIMESTONE TERRANES - GEOLOGIC INVESTIGATIONS.

Geological Survey of Alabama, University. John L. Sonderegger, and James C. Kelley.

Available from the National Technical Information Service as PB-198 277, \$3.00 in paper copy, \$0.95 in microfiche. Alabama Geological Survey Bulletin 94, Part B, 1970. 146 p, 19 fig, 6 plate, 2 tab, 44 ref, 4 append. OWRR Project B-007-ALA (3).

Descriptors: *Hydrogeology, *Karst, *Alabama, Limestones, Groundwater movement, Geology, Mapping, Maps, Geologic investigations, Geologic mapping, Geological surveys, Structural geology. Identifiers: Athens (Ala).

Limestone hydrology was studied in the Athens and Elkmont 7 1/2-minute quadrangles, an area of about 117 square miles in north-central Limestone County near the center of the northernmost tier of counties in Alabama. Solution activity is shown to be the major factor causing 'deformation' struc-tures in the northern Highland Rim section of the area. Tectonic structure has been modified by groundwater solution. Basic data in the form of measured geologic sections, and well cutting descriptions are provided. In addition, location orientation and number of joints measured in the area are shown on the geologic and contour maps. (Knapp-USGS) W71-06518

GEOHYDROLOGIC SIGNIFICANCE OF LITHOFACIES OF THE COCKFIELD FORMA-TION OF LOUISIANA AND MISSISSIPPI AND OF THE YEGUA FORMATION OF TEXAS, Geological Survey, Washington, D.C.

J. N. Payne.

Available from Superintendent of Documents, Washington, D.C. 20402 - \$6.25 (including plates in separate case). Geological Survey Professional Paper 569-B, 1970. 14 p, 2 fig, 8 plate, 1 tab, 63 ref. (Plates under separate cover).

Descriptors: *Hydrogeology, *Gulf Coastal Plain, *Mississippi River basin, *Sandstones, *Aquifers, Louisiana, Mississippi, Texas, Permeability,

Groundwater movement, Water quality, Water yield, Stratigraphy, Structural geology, Hydraulics, Sedimentation, Subsurface investigations, Borehole geophysics, Electrical well logging. Identifiers: Aquifer testing, Pumping tests, Cockfield Formation, Yegua Formation.

Sand-percentage and maximum sand-unit thickness maps show that the Cockfield and Yegua Formations in Louisiana, Mississippi, and eastern Texas consists of sediments deposited in a deltaic-fluviallain environment. An interlacing channel system was well developed in the area during Cockfield and Yegua time that is thought to be the record of the ancestral Mississippi and Trinity River systems. Sand percentage and maximum sand-unit thickness suggest that an alongshore and nearshore environment of deposition was predominant. The coefficient of permeability increases with increase in thickness of the sand body. As a consequence of this relation between permeability and thickness. the areas of greater transmissibility are found along channel paths where thick sand units were deposited. The direction of flow of water is toward the gulf coast geosyncline and the Mississippi River alluvial valley, the two principal areas of discharge. The water in and near outcrops contains appreciable amounts of calcium and magnesium. Differences in lithologic distribution and of altitude of the piezometric surfaces are vividly reflected in the regional distribution of the dissolved-solids content of waters. (Knapp-USGS) W71-06519

AVAILABILITY OF WATER IN THE MISSIS-

SIPPI EMBAYMENT,
Geological Survey, Washington, D.C.
E. M. Cushing, E. H. Boswell, P. R. Speer, and R. I Hosman

Available from Superintendent of Documents, Washington, D.C. 20402 - \$5.50 (paper cover). Geological Survey Professional Paper 448-A, 1970. 13 p, 7 fig, 7 plate, 3 tab, 86 ref. (Plates published under separate cover.)

Descriptors: *Runoff, *Gulf Coastal Plain, *Groundwater, *Aquifers, *Mississippi River basin, Water resources development, Streamflow, Water yield, Water supply, Transmissivity, Stratig-raphy, Climates, Precipitation (Atmospheric), Sur-face waters, Water levels, Water quality.

*Water Identifiers: *Mississippi embayment,

Most of the Mississippi embayment region is underlain by aquifers that will yield large quantities of water to wells, so that groundwater is the most readily available source of fresh water. Groundwater having a dissolved-solids content of less than 500 ppm is generally available at depths of less than 1,000 feet, and water having a dissolved-solids content of less than 1,000 ppm is available in some places to depths of more than 2,000 feet. Iron is the most common troublesome chemical constituent in the groundwater. The potential yield of the aquifers that underlie the region is estimated to be about 30,000 mgd, of which about 3,000 mgd is presently being withdrawn. Water in varying amounts is also available from streams within the region. The amount of water which originates within the region and which leaves it as streamflow during a year averages about 80,000 mgd. An additional 360,000 mgd leaves the region as streamflow during an average year, this amount having originated outside the region. The 1965 withdrawals from streams within the region were about 1,700 mgd. (Knapp-USGS)

W71-06520

THE DETECTION OF MAGNETIC FIELDS CAUSED BY GROUNDWATER AND THE COR-RELATION OF SUCH FIELDS WITH WATER DOWSING,

Utah Water Research Lab., Logan. For primary bibliographic entry see Field 07B. W71-06655

APPRAISAL OF THE WATER AND RELATED LAND RESOURCES OF OKLAHOMA. For primary bibliographic entry see Field 06B.

COMBINED KARST AND WATER RESEARCH IN THE DANUBE RIVER SEEPAGE REGION (BADENWURTTEMBERG) IN THE YEARS 1967-1969 (GERMAN),

H. Batsche, F. Bauer, H. Behrens, K. Buchtela, and H. J. Dombrowski.

Steirische Beitrage zur Hydrogeologie, Graz, 1970. 165 p, 72 fig, 5 plate, 15 tab, 87 ref.

Descriptors: *Groundwater movement, *Surfaceproundwater relationships, *Tracers, *Karst, Methodology, Geomorphology, Drainage effects, Sinks, Carbonate rocks, Hydrogeology, Rivers, Leakage, Water loss, River beds. Identifiers: *Danube River (Southwestern Ger-

After two years of preparatory work (hydrogeological detailed mapping and investigation of the contents of environmental isotopes of the waters) a large-scale combined tracing experiment was carried out in the area of the upper Danube (Baden-Wurttemberg, Southwestern Germany) in autumn 1969. In this area the Danube crosses the Jurassic limestone of the Schwabische Alb and loses water Inmestone of the Schwabische Alb and loses water into the karstic carbonate rocks. The labelling materials injected in various sinkholes were: 1000 kg KCl, 105 1 Dipenten, 8 kg Sulphorhodamine G extra, 250 kg Ammonbromide, 4 1 Chrome-51, 20 kg Lanthaninstrate, 400 kg detergents, 75 kg Isobornylacetate, 50 kg sodium-fluorescine, Serratia marcenses, 50 t sodium chloride, and 28 kg brown and green dyed Lycopodium spores. The cooperative experiment of institutions of Austria, Germany and Yugoslavia showed, besides the suc-cessful trying out of new labelling materials, that the Danube waters reappear in the Aach waters, and influence the groundwater conditions in the entire area between Engen, Beuren and Eigeltingen, even in places where the Jurassic limestones dip below the tertiary sediments (marl and sand-stone) towards the South. (Woodard-USGS)

BEARING ON SUBSURFACE STORAGE OF LIQUID WASTES IN MARYLAND, Geological Survey, Parkville, Md. For primary bibliographic entry see Field 05E. W71-06695

WATER RESOURCES OF RACINE AND KENOSHA COUNTIES, SOUTHEASTERN WISCONSIN.

Geological Survey, Washington, D.C. or primary bibliographic entry see Field 02E. W71-06696

FINITE ELEMENT SOLUTION OF STEADY STATE POTENTIAL FLOW PROBLEMS--THE HYDROLOGIC ENGINEERING CENTER GENERALIZED COMPUTER PROGRAM 723-G2-L2440.

Corps of Engineers, Davis, Calif. Hydrologic Engineering Center.

For primary bibliographic entry see Field 07C.

A REVIEW OF THE WORK OF THE JAROSLAV CERNI INSTITUTE FOR THE YEAR 1968.

Institut za Vodoprivredu Jaroslav Cerni, Belgrade (Yugoslavia).

For primary bibliographic entry see Field 02E.

RECHARGE OF AQUIFERS IN ARID ZONES AND EFFECTIVE POROSITY COEFFICIENT, For primary bibliographic entry see Field 04B. W71-06705

Group 2F—Groundwater

GEOHYDROLOGIC INVESTIGATIONS IN THE

MESILLA VALLEY, NEW MEXICO, New Mexico State Univ., University Park. Dept. of

Civil Engineering.
Andrew M. Taylor.
M Sc Thesis, New Mexico State University, September 1967. 130 p, 5 fig, 1 tab, 24 ref, 8 append.
OWRR Project A-008-N MEX (2).

Descriptors: *Groundwater, *Hydrogeology, *Hydrologic data, *New Mexico, Water resources, *Hydrogeology, *Hydrologic data, *New Mexico, Water resources, Geology, Aquifers, Aquifer characteristics, Water sources, Water yield, Water levels, Specific capacity, Water wells, Water quality, Withdrawal, Recharge, Glacial drift, Drawdown, Mathematical model, Evaluation, Water utilization, Hydrographs, Identifiers: *Mesilla Valley (New Mex).

Well logs, gravity data and static water levels are analyzed to develop a generalized concept of groundwater aquifers of the Mesilla Valley and adjacent areas, New Mexico. The primary source of recharge to the Mesilla Valley aquifer is from ex-cess water applied to the farmlands. During periods of normal surface-water supply, an amount of water approximately equal to the annual recharge is discharged by seepage to a network of drains located throughout the valley. The mean of the normal drain return flow therefore appears to be an normal drain return flow therefore appears to be an approximation of the normal annual recharge. Specific capacities of 23.1 gpm/ft and 8.8 gpm/ft are obtained for Southern Pacific Railroad Company for Lizard Well No. 1 and New Mexico State University Well No. 8, respectively. A safe annual withdrawal of 105,208 acre-feet/year is predicted by estimation of withdrawals from agricultural records versus the corresponding drawdowns of water levels in the aquifer. A formula to predict drawdown from withdrawals of groundwater from the aquifer of the Mesilla Valley was evaluated. The correlation between the mathematical model and observed groundwater changes tested for the drought of 1951 to 1958 is reasonable. (See also W70-04399) (Woodard-USGS) W71-06729

GROUNDWATER AND WELLS.

University Oil Products, St. Paul, Minn. Johnson

For primary bibliographic entry see Field 04B. W71-06920

GEOPHYSICS AS AN AID TO THE SMALL WATER WELL CONTRACTOR,

Lansing Board of Water and Light, Mich. For primary bibliographic entry see Field 04B. W71-06946

GROUNDWATER IN THE ADEN SECTOR OF SOUTHERN ARABIA,

Geological Survey, Arlington, Va.

D. J. Cederstrom. Groundwater, Vol 9, No 2, p 29-34, March-April 1971. 6 p, 2 fig, 10 ref.

Descriptors: *Water resources development, *Water wells, *Deserts, Water supply, Groundwater, Recharge, Water balance, Alluvium, Aquifers, Water table, Hydrogeology. Identifiers: *Aden, *Arabia.

A reconnaissance of parts of the former West Aden Protectorate, Arabia, enables a characterization of the dominant hydrologic elements. In this desert environment, intermittent streams from the eastwest range of mountains provide considerable water for flood irrigation and groundwater recharge of alluvial fans along the Gulf of Aden. High yield wells are developed in the coastal area and in alluvial areas on the back slope facing the Empty Quarter. Groundwater in the interior is generally restricted to areas where wadi flow provides occasional recharge. Relatively few rock wells have been drilled in the area. Many wells in the alluvium yield silty water leading to clogging of the wells and undue pump wear. (Knapp-USGS) W71-07003

FUTURE DEMANDS ON GROUNDWATER IN NORTHEASTERN ILLINOIS, Illinois State Water Survey, Urbana. For primary bibliographic entry see Field 06D. W71-07004

ON THE MANAGEMENT OF GROUNDWATER IN COASTAL AQUIFERS,

North Carolina State Univ., Raleigh. Dept. of Civil

Engineering.
For primary bibliographic entry see Field 04B.
W71-07005

A SHORTCUT FOR COMPUTING STREAM DEPLETION BY WELLS USING ANALOG OR DIGITAL MODELS,

Geological Survey, Denver, Colo. For primary bibliographic entry see Field 07C. w71-07006

GROUNDWATER FLUCTUATIONS RESPONSE TO ARBITRARY PUMPAGE, Illinois State Water Survey, Urbana.

Groundwater, Vol 9, No 2, p 4-8, March-April 1971. 5 p, 6 fig, 10 ref.

Descriptors: *Water level fluctuations, *Unsteady flow, *Groundwater movement, *Withdrawal, *Computer programs, Water table, Aquifers, Drawdown, Hydrogeology, Mathematical studies, Confined water, Artesian wells, Mathematical models, Theis equation, Analog models, Illinois, Simulation analysis.

Identifiers: Artesian aquifers.

The problem of predicting water level changes in an aquifer due to variable pumpage is approached by using the convolution integral. Equations are given for a nonleaky artesian aquifer and a leaky artesian aquifer with negligible storage in the confining layer. Computational results compare favorably with type curves for hypothetical cases with constant pumping. A practical example using variable pumpage from pumping centers shows the applicability of the technique and its value in interpreting water level variations. (Knapp-USGS) W71-07007

HYDROTHERMAL EXPLOSION CRATERS IN

YELLOWSTONE NATIONAL PARK,
Geological Survey, Menio Park, Calif.
L. J. P. Muffler, D. E. White, and A. H. Truesdell.
Geological Society of America Bulletin, Vol 82, No 3, p 723-740, March 1971. 18 p, 10 fig, 38 ref.

Descriptors: *Craters, *Explosions, *Thermal water, *Steam, National parks, Wyoming, Thermal springs, Subsurface waters, Geothermal studies, Groundwater movement, Surface-groundwater

relationships.
Identifiers: *Hydrothermal explosions, *Steam explosions, Yellowstone National Park.

Hydrothermal explosions are produced when water contained in near-surface rock at temperatures as high as perhaps 250 deg C flashes to steam and violently disrupts the confining rock. These explosions are due to the same instability and chain reac-tion mechanism as geyser eruptions but are so violent that a large proportion of solid debris is expelled along with water and stream. At least ten hydrothermal explosion craters, ranging in diameter from a few tens of feet to about 5000 ft, are in Yellowstone National Park. Eight of these craters are in hydrothermally cemented glacial deposits; two are in Pleistocene ash-flow tuff. Each is surrounded by a rim composed of debris derived from the crater. Geologic relations at the Pocket Basin crater establish that the explosion there took place during the waning stages of early Pinedale Glacia-tion. An ice-dammed lake may have existed over a hydrothermal system at the Pocket Basin site; the hydrothermal explosion was triggered by the abrupt decrease in confining pressure consequent in sudden draining of the lake. Most of the other explosion craters in Yellowstone Park could have been triggered in the same manner. (Knapp-USGS) W71-07008

NOTE ON HYDROLOGICAL RESEARCH IN BOTSWANA WITH SPECIAL EMPHASIS ON RESEARCH IN THE HYDROGEOLOGICAL FIELD,

Botswana Geological Survey, Lobatsi.

C. M. H. Jennings.
South Africa Journal of Science, Vol 67, No 1, p 12-21, January 1971. 10 p, 13 ref.

Descriptors: *Surveys, *Hydrogeology, *Water resources development, Aquifers, Borehole geophysics, Water wells, Aquifer characteristics, Transmissivity, Storage coefficient, Safe yield, Infiltration, Water balance, Radioactive dating, Reviews, Foreign research.
Identifiers: *Botswana.

Climatically Botswana is a semi-arid country with a variable and uncertain rainfall. Some rivers in northwestern Botswana are perennial, but all other rivers are ephemeral in nature. Emphasis has been placed for many years on the development and utilization of underground water resources. As a result a considerable body of hydrogeological data has been built up. Research work is also being carried out and this has included the establishment of observation boreholes in selected areas, where by taking daily, weekly or monthly water rest level measurements related to statistics of underground water use and rainfall data, information is being compiled which will lead eventually to determina tions on transmissibility, storage capacity, safe yields and infiltration rates for certain important aquifers. As an adjunct to this work systematic chemical analyses and temperature measurements of all groundwaters are carried out. Carbon-14 and tritium dating of groundwaters is in progress. Additional information is being obtained or is planned from resistivity and spontaneous-potential logging of boreholes. (Knapp-USGS) W71-07026

WELLS AND SPRINGS IN CALIFORNIA AND NEVADA WITHIN 100 MILES OF THE POINT 37 DEGREE 15' N., 116 DEGREE 25'W., ON NEVADA TEST SITÉ,

Geological Survey, Denver, Colo. For primary bibliographic entry see Field 04B. W71-07029

USE OF GROUNDWATER FOR IRRIGATION IN HAMILTON AND YORK COUNTIES, NEBRASKA,

Geological Survey, Lincoln, Nebr.

Eugene K. Steele, Jr. Nebraska Water Survey Paper No 27, February 1971. 43 p, 18 fig, 4 tab, 13 ref.

Descriptors: *Groundwater, *Water wells, *Irriga-tion, *Water level fluctuations, *Nebraska, Withdrawal, Drawdown, Hydrographs, Aquifers, Water yield, Precipitation (Atmospheric), Pumping, Discharge measurement, Hydrologic data, Data collections.

Identifiers: Hamilton and York Counties (Nebr).

About 317,000 acres, or 45 percent of the land in Hamilton and York Counties, Nebraska, is irrigated with water pumped from wells. Beginning in 1961, a downward trend of water levels in wells indicated that the groundwater supply was being depleted progressively in a large part of the two counties. Comparison of water levels in the spring of 1970 with estimated water levels prior to irrigation development indicates a net decrease of nearly 1 million acre-feet in the stored supply. Withdrawal during the 1969 irrigation season (about 400,000 acre-feet) apparently did not contribute significantly to the long-term net decrease; the weighted water-level change (1969 to 1970) corresponded to only a very small change in storage. Hydrographs of water-level changes since 1958 in 10 wells indicate that 1969 pumpage was much less than pumpage in the years 1963-67, when the downward trend of water levels was the steepest. (Woodard-

W71-07031

SEASONAL VARIATIONS, SULPHUR MOUN-TAIN HOT SPRINGS, BANFF, ALBERTA,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
R. O. Van Everdingen.

Canada Dept of Energy, Mines and Resources, Inland Waters Branch Technical Bulletin No 33, 1970. 11 p, 5 fig, 2 tab, 3 ref.

Descriptors: *Water chemistry, *Spring waters, *Hot springs, *Hydrologic data, *Water properties, Fluctuation, Seasonal, Water temperature, Flow, Chemical properties, Chemical analysis, Dissolved Chemical properties, Chemical analysis, Dissolved solids, Dissolved oxygen, Data collections, Geochemistry, Thermal water, Mineral water, Thermal springs, Hydrogen sulfide. Identifiers: *Hot Springs (Banff, Alberta), Canada.

Seasonal variations in the physical and chemical parameters of the sulfurous hot springs on Sulphur Mountain near Banff, Alberta, occur between late April and early August as a result of the influx of varying quantities of water having temperatures and dissolved-solids concentrations lower than the sulfurous thermal water. In the absence of accurate discharge measurements, only a 'minimum required' mixing ratio could be calculated, leading to minimum ion concentrations and a minimum temperature for the cooler water. The Kidney Spring just below the Upper Hot Spring, and the Cave Spring behind the Cave-and-Basin Aquacourt were selected as subjects for this program because of their accessibility and the limited amount of human interference with their free flow. The variations in water temperatures and dissolved-solids concentrations for the Kidney Spring and the Cave Spring are shown. The graphical representation of the chemical analyses for the Kidney Spring shows that the low-temperature period is characterized by a decrease in the concentrations of all dissolved components except alkalinity. (Woodard-USGS)

PUMPAGE AND GROUNDWATER STORAGE DEPLETION IN CUYAMA VALLEY, CALIFOR-NIA, 1947-66,

Geological Survey, Menlo Park, Calif. For primary bibliographic entry see Field 04B. W71-07039

WATER WELL EXPLOSIONS: AN ENVIRON-

MENTAL HAZARD, Pennsylvania State Univ., University Park. Coll. of Earth and Mineral Sciences.

For primary bibliographic entry see Field 04B. W71-07040

A TIME SERIES FROM THE BEACH EN-VIRONMENT - II, Virginia Inst. of Marine Science, Gloucester Point.

For primary bibliographic entry see Field 02J. W71-07047

GEOLOGY AND WATER RESOURCES OF CAMPBELL COUNTY, SOUTH DAKOTA-PART II: WATER RESOURCES, Geological Survey, Huron, S. Dak.

Neil C. Koch.

South Dakota Geological Survey Bulletin 20, 1970. 38 p, 18 fig, 5 tab, 17 ref.

*Hydrogeology, Descriptors: *Groundwater, *Hydrologic data, *Water resources development, *South Dakota, Aquifers, Aquifer characteristics, Glacial drift, Water sources, Water yield, Water levels, Specific capacity, Water wells, Water quality, Withdrawal, Consumptive use, Irrigation, Domestic water, Recharge, Surface-groundwater relationships, Hydrographs.

Identifiers: *Campbell County (S. Dak.).

Campbell County, an area of 763 square miles, is in the north-central part of South Dakota, is bounded on the west by the Missouri River and on the north by North Dakota. The county is nearly covered by glacial drift and lake deposits of Pleistocene age, and alluvium and colluvium of Holocene age. These sediments range in thickness from a thin veneer to more than 475 feet and overlie the Pierre Shale and Fox Hills Formations of Cretaceous age. A deep-glacial aquifer, composed mostly of outwash, underlies about 20 percent of the county, averages 100 feet in thickness, and contains about 2 1/2 million acre-feet of water in transient storage. This aquifer supplies about 11 percent of the water used in the county. Shallow-glacial aquifers cover 40 percent of the county and yield as much as 500 gpm to wells. There is about 1 million acre-feet of water in transient storage. Shallow aquifer water is more suitable for irrigation than deep aquifer water. Both aquifers contain water that is high in bicarbonate and sulfate. The shallow-glacial water is generally high in calcium, whereas the deep-glacial water is always high in sodium. The artesian Dakota and Fall River aquifers underlie all of Campbell County at a depth of about 2,000 feet. These aquifers furnish water of sufficient quantity for domestic and farm needs by flowing wells. Because of excessive mineralization this water is not suitable for irrigation. (Woodard-USGS) W71-07048

2G. Water in Soils

INORGANIC PHOSPHATE TRANSFORMA-TION IN WATERLOGGED SOILS, Louisianna State Univ., New Orleans. For primary bibliographic entry see Field 05B.

MOVEMENT OF 2,4-D IN SOILS, New Mexico Agricultural Experiment Station, University Park.

For primary bibliographic entry see Field 05B.

EFFECT OF STRAIN HISTORY ON LIQUEFAC-

TION OF SAND,
British Columbia Univ., Vancouver. Dept. of Applied Science; British Columbia Univ., Vancouver. Dept. of Civil Engineering, and Partner, Cook, Pickering and Doyle Ltd., Vancouver. W. D. Liam Finn, Peter L. Bransby, and Dennison

J. Pickering.

ASCE Proceedings, Journal of the Soil Mechanics and Foundations Division, Vol 96, No SM 6, p 1917-1934, November 1970. 18 p, 12 fig, 4 ref, ap-pend. Nat Res Council of Canada Grant No 1498.

Descriptors: *Soil mechanics, *Sands, *Quicksand, *Shear stress, Soil water, Strain, Earth materials, Seepage, Soil engineering, Soil physical properties, Soil strength.

Identifiers: Liquefaction (Sands).

The resistance of a saturated sand to liquefaction under cyclic loading depends on the void ratio, effective stress system and intensity of cyclic loading. The effect of strain history on the resistance to liquefaction was investigated by means of triaxial and simple shear tests. The resistance of a saturated sand to liquefaction is influenced strongly by the previous strain history. Partial liquefaction, which occurs at small shear strains, greatly increases the resistance to liquefaction in subsequent tests. Cycles of large shear strains, or quasi-static shear strains greater than 7.5%, reduces the resistance to liquefaction. The increase in resistance to liquefaction created by a very small shear strain may result from the elimination of small local instabilities in the original sand structure. The loss of resistance caused by larger shear strains is thought to be due to either the creation of a uniform metastable structure or the development of a non-uniform structure. (Knapp-USGS)
W71-06700

SOIL MOISTURE TYPES OF THE AMUR OBLAST (Russian: Tipy Uvlazhennosti Landshaf-tov Amurskoy Oblasti),

lov Amursky, Orlasty, L. F. Nasulich. In: Teplovoy i Vodnyy Rezhim Nekotorykh Rayonov Sibiri, Leningrad, 'Nauka', p 58-81, 1970. 24 p, 1 map, 14 ref.

Descriptors: *Soil water, *Soils, *Soil moisture, *Hydrogeology, Geomorphology, Streamflow, Land reclamation, Saturated soils, Soil properties, Flooding, Hydrologic aspects, Drainage, Surfacegroundwater relationships, Erosion control, Forest management, Water management (Applied). Identifiers: *Amur Oblast (USSR)

Natural landscapes of the Amur Oblast are examined from the standpoint of soil water and moisture types. Field studies have established 11 soil moisture types, of which 6 are in the forest zone and 5 in the forest-steppe zone. Landscapes described include waterlogged, forested and meadow high plains, forested and scrub flood plains, water logged and forested high flood plains, forested mountains, meadow low and high flood plains, meadow-steppe, forest-steppe and cultivated high plains. Standard correlations are established for constructing various aspects of the winter hydrothermal regimen of the landscape on the basis of snow gage survey data. Reclamation practices aimed at controlling flooding, waterlogging and excess with the property of the prope cessful land management of reclaimed and recently meliorated soils of varying moisture. To implement these practices, the causes and extent of water-logging, characteristics of the relief, and the genesis of physical, chemical and other soil properties must be known. (See also W71-06707) (Josefson-USGS) W71-06710

THE RETENTION OF SELECTED RADIONUCLIDES FROM DILUTE SOLUTIONS

BY PANAMANIAN CLAYS,
Florida Univ., Gainesville. Dept. of Environmental
Engineering; and Florida Univ., Gainesville. Inst. of
Food and Agricultural Sciences.
For primary bibliographic entry see Field 05B.
W71-06716

THE NUCLEAR METHOD OF SOIL-MOISTURE DETERMINATION AT DEPTH, Texas Univ., Austin. Center for Highway Research. Clarence J. Ehlers, Lymon C. Reese, and James N.

Anagnos.

Available from NTIS as PB-194 749, \$3.00 in paper copy, \$0.95 in microfiche. Research Report 89-4, June 1969. 66 p, 29 fig, 1 tab, 14 ref. DOT supported.

Descriptors: Soil moisture.

Identifiers: *Radiation measuring instruments, *Soil water, *Moisture content, Soils, Performance tests, Neutron absorption, Soil mechanics.

The results are presented of an investigation conducted for the primary purpose of studying the capabilities, limitations, and problems associated with the nuclear method of moisture determination at depth. Nuclear equipment manufactured by Troxler Electronic Laboratories, Inc., was used to measure moisture changes at depth at three different test sites. Moisture contents were obtained using the manufacturer's calibration curve, with the accuracy of the manufacturer's curve being checked in the field by comparing nuclear and gravimetric results. The effect of air gap, the reproducibility of a neutron count, and time and temperature effects were also investigated. The major problem associated with the nuclear method during the investigation was concerned with access-tube installation; a possible solution of the problem in soil containing gravel is discussed. Results showed that the nuclear method of soilmoisture determination was fast and efficient. The accuracy of the nuclear method was found to be satisfactory when compared to gravimetric results, and recalibration of the nuclear equipment was not

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necessary. The nuclear method is recommended for studies concerned with the measurement of soil-moisture changes at depth.

SEEPAGE CHARACTERISTICS OF EXPLO-SIVELY PRODUCED CRATERS IN SOIL AND

Army Engineer Nuclear Cratering Group, Livermore, Calif.; and Army Engineer Waterways Experiment Station, Vicksburg, Miss.
Walter C. Sherman, and Don C. Banks.

Available from NTIS as AD-715 727, \$3.00 in paper copy, \$0.95 in microfiche. Nuclear Cratering Group Technical Report No 27, Livermore, Calif, Aug 1970. 72 p.

Descriptors: *Soil physical properties, *Permeability, *Seepage, *Rock properties, Groundwater, Porosity, Craters, Excavation, Nuclear explosions, Laminar flow, Mathematical models, Drainage.

This report contains a review of the permeability characteristics of soil and rock formations in both disturbed and undisturbed conditions which are likely to occur in the zones surrounding craters. The report presents methods of determining permeability and tabulates typical values of permeability in a variety of materials. Factors which affect the seepage characteristics of craters are discussed, and a few examples are presented to illustrate the influence of seepage on stability cal-culations. The data indicate that laminar-flow conditions will prevail in soil and rock formations, dependent upon the size of the pore opening and hydraulic gradient. For a given pore opening, a critical gradient exists above which the flow is found to be turbulent; the technique of constructing flow nets for turbulent flow is illustrated in the report. The correct assessment of seepage conditions in the zones surrounding a crater will depend to a large extent upon the correct evaluation of boundary conditions, such as geological discontinuities and sources of seepage. W71-06781

AN IRREVERSIBLE THERMODYNAMIC AP-PROACH TO SIMULTANEOUS MOVEMENT OF WATER, HEAT, AND SALT THROUGH UN-SATURATED SOILS, Battelle-Northwest, Richland, Wash. Pacific

Northwest Lab.

C. G. Enfield.

Available from NTIS as BNWL-1429, \$3.00 in paper copy, \$0.95 in microfiche. Report BNWL-1429, August 1970. 42 p, 2 fig, 48 ref.

Descriptors: Flow, *Thermodynamics, *Heat, *Soil water, Soil moisture, Diffusion, Hydraulic conductivity, Osmotic pressure, *Salts.

Literature was reviewed to obtain the basis for the simultaneous flow of water, heat, and salt through unsaturated soils. Flow theories were developed from the general theory of water flow in saturated soil under isothermal conditions to the analysis of simultaneous solution flow caused by two driving forces, such as water and heat, using irreversible thermodynamics. Based on this review, conclusions were made that the theory of irreversible thermodynamics is the most applicable approach for modeling when both liquid and vapor transport are to be considered. W71-06795

2H. Lakes

ON THE STAGNATION AND RECENT TUR-NOVER OF THE WATER IN THE BALTIC. Fishery Board of Sweden, Goteborg. Hydrographic Department.

For primary bibliographic entry see Field 05C. W71-06498

SOME LIMNOLOGICAL OBSERVATIONS FROM ENDERBY LAND, ANTARCTICA, Lehigh Univ., Bethlehem, Pa. Center for Marine

and Environmental Studies.

F F MacNamara.

Translated from Informatsionnyi Byulleten' Sovetskoi Antarticheskoi Ekspeditsii, No 72, Soviet Antarctic Expedition Information Bulletin, Vol 7, No 3, p 246-255, January 1971. 10 p, 3 fig, 3 tab 46 ref.

Descriptors: *Limnology, *Antarctic, *Lakes, Ice, Melt water, Water quality, Water chemistry, Primary productivity, Climates, Water balance, Temperature. Thermal stratification.

Identifiers: *Antarctica, *Enderby Land (Antarc-

The physical and chemical properties and seasonal dynamics of freshwater lakes, ponds, and meltpools of coastal ice-free areas of Enderby Land, Antarctica are discussed. The waters are significantly less mineralized than has been reported in other icefree areas of the Antarctic. Tentative explanations are location with respect to strom tracks, and true meltwater nature of the lakes. Primary production was variable dependent on many factors. Seasonal temperature cycles in water bodies are factors to be considered in primary production studies. (Knapp-W71-07017

STUDY OF LAKES IN THE VICINITY OF

MOLODEZHNAYA STATION, Arkticheskii i Antarkticheskii Nauchno-Issledovatelskii Institut, Leningrad (USSR). M. V. Aleksandrov, and A. M. Kozlovskiy

Translated from Informatsionnyi Byulleten' Sovetskoi Antarticheskoi Ekspeditsii, No 72, p 34, 1968. Soviet Antarctic Expedition Information Bulletin, Vol 7, No 3, p 256-259, January 1971. 4 p, 2 fig, 1 tab, 8 ref.

Descriptors: *Limnology, *Antarctic, *Lakes, Ice, Melt water, Water quality, Water chemistry, Primary productivity, Climates, Water balance, Temperature, Thermal stratification.

Identifiers: *Antarctica, *Enderby Land (Antarc-

In 1967, the glaciological-hydrographic party of the Soviet Antarctic expedition studied the lakes in the coastal area of the western part of Enderby Land. All the lakes encountered are confined to Molodezhnaya Oasis, Vecherniy Oasis, and other small, ice-free land areas. Some shallow and small lakes that lose their ice cover in summer warm up very strongly in summer. Their heat content is quite high. For example, water temperature measurements performed jointly with Japanese scientists on August 25, 1967, in Lake Teploye (provisional name) showed its temperature to be 3.8 deg C in the bottom layer at a depth of 4.8 m, even in the presence of an ice cover 1.6 m thick. All the lakes investigated are fresh, belong to the high-latitude category of lakes, and are fed by snow and ice. They can be divided into two groups according to their ice and thermal regimes: lakes with a per-sistent ice cover, and lakes that clear of ice in summer. (Knapp-USGS) W71-07018

CHEMISTRY OF WATER, ICE, AND SNOW IN THE SCHIRMACHER PONDS,

Arkticheskii i Antarkticheskii ledovatelskii Institut, Leningrad (USSR).
I. M. Simonov, and K. S. Bonch-Osmolovskaya

Translated from Informatsionnyi Byulleten' Sovetskoi Antarticheskoi Ekspeditsii, No 72, p 41, 1968. Soviet Antarctic Expedition Information Bulletin, Vol 7, No 3, p 260-264, January 1971. 5 p, 2 fig, 1 tab, 8 ref.

Descriptors: *Limnology, *Antarctic, *Lakes, *Water chemistry, Weathering, Saline water intrusion, Melt water, Water quality, Water chemistry, Climates, Water balance, Temperature. Identifiers: *Antarctica, *Schirmacher Ponds (Antarctica).

The presence of numerous lakes is a characteristic feature of the landscape of the Schirmacher Ponds. Antarctica. There are more than 50 lakes of various sizes in the area. Glacial lakes predominate according to the origin of the water masses and lake basins. The basins were formed by ice excavation. There are also relicit lakes, formed as a result of isolation of sea inlets and lagoons. Most lakes are either drainless or have intermittent drainage. The lakes are fed by meltwater that flows into them only during the short summer, when there is intense melting of numerous snow beds and of the ice slope. In the first five samples, the not readily solu-ble salts are represented almost exclusively by calcium carbonate, whose content ranges from 0.16 to 0.22 meq/liter. The content of these salts is higher in the waters of Lakes Rozovoye and Krasnoye. In the water sample from Lake Rozvoye, these salts are represented mainly by calcium sulfate (6.38 meq/liter), and in that from Lake Krasnoye, by calcium carbonate (0.54 meq/liter). The water samples from the other lakes do not contain calcium sulfate and their calcium carbonate content is about 0.10 meq/liter; and the content of magnesium carbonate increases gradually from 0.06 to 0.18 meq/liter. All the lakes of the Schirmacher Ponds are fresh. Salts of sea water may penetrate into epishelf lakes because of their contact with the ocean. Sea salts are also brought to the coastal zone of the continent as aerosol by cyclonic winds together with precipitation. Salts are also brought by fresh waters from weathering zones on lakes located in the southern and southeastern parts of Ponds. In the course of weathering, the fresh waters from the continent are enriched with alkali bicarbonates. The freshening effect of snow and ice meltwaters is manifested through an increase of the amount of sulfate, then chloride, and finally, bicarbonate of alkali elements in the Lake waters. (K-napp-USGS) W71-07019

INSTRUMENTATION FOR STUDY OF ENER-GY BUDGET OF RAWSON LAKE,

Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch. For primary bibliographic entry see Field 02D.

DETERMINATION OF SOME CHEMICAL AND PHYSICAL RELATIONSHIPS FROM RECORDING METERS IN LAKES,
Ontario Water Resources Commission, Toronto.

For primary bibliographic entry see Field 05A. W71-07045

2I. Water in Plants

PROBLEMS OF THROUGHFALL AND INTER-CEPTION ASSESSMENT UNDER TROPICAL FOREST,

University Coll., Dar-es-Salaam (Tanzania).

I. J. Jackson. Journal of Hydrology, Vol 12, No 3, p 234-254, February 1971. 21 p, 7 fig, 8 tab, 18 ref.

Descriptors: *Tropical regions, *Interception, *Throughfall, *Precipitation (Atmospheric), Statistical methods, Variability, Regression analysis, Evaporation, Forest, Rain forests, Wet climates Statements. mates, Storms. Identifiers: *Tropical forests.

A rain gaging experiment in a highland area of northern Tanzania showed the influence of skewness and great variability of throughfall data. For heavy storms, large standard errors make interception estimates unreliable. The techniques of analysis used have a considerable influence on throughfall and interception estimates. Since most previous detailed studies were carried out in temperate latitudes, the effect of tropical foliage upon

Erosion and Sedimentation—Group 2J

interception was poorly known. The graph of interception (median values) against gross rainfall indicates a non-linear relationship and also illustrates the considerable scatter of the data. Attempts to fit a polynomial curve and a logarithmic polynomial curve to storms of under 20 mm proved of little value. Interception values range widely both for individual storms and periods in response to climatic and vegetation factors. This study suggests that interception in tropical forests is fairly low compared to that in temperate forests. (Knapp-USGS) W71-06474

2J. Erosion and Sedimentation

GRAIN SIZE, MINERALOGY AND CHEMISTRY OF A QUICK-CLAY SAMPLE FROM THE ULLENSAKER SLIDE, NORWAY, San Diego State Coll., Calif.; and Oslow Univ. (Norway). Inst. of Geology. Richard W. Berry, and Per Jorgensen. Engineering Geology, Vol 5, No 1, p 73-84, February 1971. 12 p, 7 fig, 5 tab, 13 ref.

Descriptors: *Clays, *Glacial drift, *Quick clays, X-ray diffraction, Differential thermal analysis, Particle size, Clay minerals, Mineralogy, Soil mechanics, Mass wasting, Mechanical properties. Identifiers: *Norway.

A detailed laboratory study was made of a quickclay from a recent quick-clay slide at Ullensaker in Romerike, approximately 40 km northeast of Oslo, Norway. The material is a Quaternary glacial clay, deposited in a marine basin. The clay was studied by fractionation according to grain size, and by mineralogical chemical analyses. Water content is 44.2%; plastic limit is 28.5%; content of particles less than 2 microns is 42%; liquid limit is 43.3%; plasticity index is 14.8; and its activity is 0.35. The median size shows that this is a coarse clay, nearly a silt. The clay is poorly sorted. The dominant mineral in the over 4 micron fraction is quartz. The abundance of quartz fell sharply between 4 and 2 ranges. Feldspar follows the same pattern. The 0.2-0.1 micron fraction shows X-ray peak intensities for illite and chlorite far greater than can be explained by the removal of the quartz dilutant. (K-napp-USGS)
W71-06464 microns to a minor constituent in the smaller size

GEOCHEMICAL AND GEOLOGICAL RECON-NAISSANCE IN THE SEVENTYMILE RIVER AREA, ALASKA,

Geological Survey, Washington, D.C. Sandra H. B. Clark, and Helen L. Foster.
For sale by Superintendent of Documents, U.S.
Government Print Office, Washington, D.C. 20402
- Price \$0.25. Geological Survey Bulletin 1315,
1971. 21 p, 9 fig, 1 tab, 14 ref.

Descriptors: *Geology, *Hydrogeology, *Geochemistry, *Alaska, *Mineralogy, Sampling, Streams, Sediments, Rocks, Soils, Metals, Physical properties, Chemical analysis. Identifiers: *Seventymile River (Alaska).

Geochemical data were secured from 322 streamsediment samples, 207 rock samples, and 76 soil samples collected in the Seventymile River area. Geochemical anomalies occur in the Flume Creek-Alder Creek, Crooked Creek, American Creek, and Eagle Bluff areas. Gold in the Flume Creek-Alder Creek area south of the Seventymile River is believed to be associated with ultramafic bodies in a fault zone. Placer gold and other metals in anomalous amounts in stream sediments north of the Seventymile River in the Crooked Creek area may be related to dikes and faults that cut Tertiary and Tertiary sedimentary rocks. Geochemical sampling in the American Creek and Eagle Bluff areas did not define any new mineral deposits, but several anomalies of unknown origin are worthy of further investigation. (Woodard-USGS) W71-06466

THEORETICAL MODEL FOR MANGANESE DISTRIBUTION IN CALCAREOUS SEDIMENT CORES.

Institut de Physique du Globe, Paris (France). Gil Michard.

Journal of Geophysical Research, Vol 76, No 9, p 2179-2186, March 20, 1971. 8 p, 3 fig, 2 tab, 14 ref. CNEXO Contract 70 C1917.

Descriptors: *Water chemistry, *Manganese, *Bottom sediments, *Connate water, Ion transport, Calcium carbonate, Diffusion, Distribution patterns, Solubility, Oxidation-reduction potential, Oxida-

tion-carbonate rocks.
Identifiers: *Manganese distribution (Sediments), Calcareous sediments.

A steady state model for manganese distribution in calcareous sediment is presented. In this diffusion-advection model, the chemical reactions involved are (1) Mn... is oxidized in the top, and (2) Mn... is sorbed on the solid phase in the reducing conditions of the bottom. A general mathematical solution is given. (Knapp-USGS) W71-06468

DISSOLVED, SUSPENDED AND BED LOAD MOVEMENT PATTERNS IN TWO O'CLOCK CREEK, ROCKY MOUNTAINS, CANADA, SUMMER, 1969, Alberta Univ., Edmonton.

H. J. McPherson.

Journal of Hydrology, Vol 12, No 3, p 221-233, February 1971. 13 p, 7 fig, 2 tab, 11 ref. NRC of Canada Grant A 4241.

Descriptors: *Sediment yield, *Sediment load, *Small watersheds, *Rocky Mountain Region, Suspended load, Bed load, Aqueous solutions, Sedimentation, Erosion, Sediment transport, Provenance, Sediment discharge. Identifiers: *Canada, *Alberta (Canada).

During the summer of 1969, 12850 tons of material were removed as suspended sediment load, 440 tons as dissolved load and 65 tons as bed load from Two O'Clock Creek Basin in the Canadian Rockies. This is equivalent to a surface lowering of the basin by 0.0195 inches per year, a figure which agrees very well with rates of denudation reported by researchers for other mountain areas. During the peak snow melt generated flood in early June, 87% of the total sediment load was exported. Most of the remainder was transported out of the basin by a secondary high flow resulting from rainfall and snow melt in early July. The single most intense rainstorm of the season on August 5 and 6 resulted in a minor increase in stream flow but no increase in sediment discharge. (Knapp-USGS) W71-06473

CONCEPT OF CRITICAL SHEAR STRESS IN LOOSE BOUNDARY OPEN CHANNELS, West Virginia Inst. of Tech., Montgomery. Dept. of

Civil Engineering. For primary bibliographic entry see Field 08B. W71-06482

SEDIMENT TRANSPORTATION MECHANICS: H. SEDIMENT DISCHARGE FORMULAS.

ASCE Proceedings, Journal of the Hydraulics Division, Vanoni, Vito A., Chairman, Task Committee on Sedimentation, Vol 97, No HY4, Paper 8076, p 523-567, April 1971. 45 p, 24 fig, 3 tab, 40 ref.

Descriptors: *Sediment transport, *Bed load, *Sediment load, Sedimentation, Alluvial channels, Discharge (Water), Sediment discharge, Streamflow, Stage discharge relations. Identifiers: Sediment discharge formulas.

Thirteen well known sediment discharge formulas are presented with a view to making them convenient to use. The basis for each formula is outlined and results of measured bed sediment discharge on two sand bed streams are compared

with values calculated with each of the 13 formulas. This is done on a graph of sediment discharge against water discharge for the two streams. In these calculations the relation between water depth, velocity and discharge was calculated by the Einstein-Barbarossa method. These comparisons of results calculated by formulas with measurements and with each other are interesting in that they bring out the great variability of the calculated sediment discharges. However they are of only limited value in determining the general reliability of each formula. (Knapp-USGS) W71-06483

INITIATION OF RIPPLES ON FLAT SEDI-MENT BEDS.

Bechtel Corp., San Francisco, Calif., Slurry Pipeline Development; and University Coll., Lon-don (England). Dept. of Civil Engineering. Philip B. Williams, and Patrick H. Kemp.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 97, No HY4, Paper 8042, p 505-522, April 1971. 18 p, 10 fig, 10 ref, append.

Descriptors: *Channel morphology, *Scour, *Ripple marks, *Sedimentary structures, *Hydraulic models, Alluvial channels, Sediment transport, Bed load, Turbulent flow, Turbulence, Vortices, Velocity, Reynolds number, Flumes, Open channel flow, Particle size. Identifiers: Sediment transport models.

For natural sands under turbulent water flow, ripples were found in flume tests, to form on a flat bed from small deformations caused by the random action of high turbulent velocities close to the bed. The deformations affect the grain movement pat-tern so as to form a bed disturbance or collection of grains that induce a separation eddy to form. The height of such a disturbance was found to be of the order of two or three grain diameters, and the height-to-length ratio is of the order of 1 to 100. Sands with median diameters of 137 micron and 495 micron were used in the experiments. The definition of initial movement of fine sediment established by Grass was extended by these experiments to define the critical conditions for the initiation of ripples from a flat bed. Additional experiments were made in which the grain Reynolds Number was varied by varying the temperature and thus the viscosity of the water. The results sug-gested that the described mechanism of ripple formation does not operate for grains larger than 600 micron at normal temperatures. (Knapp-USGS) W71-06484

DEVELOPMENT OF A MEANDERING THAL-WEG IN A STRAIGHT, ERODIBLE LABORA-TORY CHANNEL, Geological Survey of Israel, Jerusalem.

For primary bibliographic entry see Field 08B.

APPLICATIONS OF INFORMATION AND GRAPH THEORY TO MULTIVARIATE GEOMORPHOLOGICAL ANALYSES,

Colorado Univ., Boulder. Inst. of Arctic and Alpine Research; and Colorado Univ., Boulder. Dept. of Geological Science.

For primary bibliographic entry see Field 07C. W71-06486

MORPHOLOGY AND QUATERNARY HISTORY OF THE CONTINENTAL SHELF OF THE GULF COAST OF THE UNITED STATES,

Office of Naval Research, Boston, Mass.; and Woods Hole Oceanographic Institution, Mass. Robert D. Ballard, and Elazar Uchupi. Bulletin of Marine Science, Vol 20, No 3, p 547-559, 1970. 13 p, 2 fig, 35 ref.

Descriptors: *Continental shelf, *Gulf Coastal Plain, *Sea level, *Water level fluctuations, *Geomorphology, Sedimentation, Stratigraphy, Quaternary Period, Tidal effects, Topography,

Field 02—WATER CYCLE

Group 2J—Erosion and Sedimentation

Epoch. Pleistocene geology, Structural Paleohydrology.
Identifiers: Historical geology.

Sea-level fluctuations of the Quaternary have greatly influenced the surface morphology of the continental shelf off the gulf coast of the United States. Two prominent shorelines, at 60- and 160meter depths, and other features found on the gulf shelf can be related to the relatively recent events of the Quaternary, particularly those of the Holocene transgression. Landward of the 40-meter contour, the slow rise of the sea surface and modern sedimentation have produced a complex mixture of topographic expressions. Diapiric structures, which are abundant from De Soto Canyon westward, appear to be of secondary importance in contributing to the shelf's surface relief. (Knapp-USGS) W71-06493

THE QUANTITY, COMPOSITION AND DISTRIBUTION OF SUSPENDED PARTICULATE MATTER IN THE GULF OF CALIFORNIA, Scripps Institution of Oceanography, La Jolla, Calif.

For primary bibliographic entry see Field 05A. W71-06494

INTERSTITIAL WATER STUDIES ON SMALL CORE SAMPLES, LEG 4,

Woods Hole Oceanographic Institution, Mass.; Geological Survey, Woods Hole, Mass.; and California State Coll., Long Beach. For primary bibliographic entry see Field 02K. w7i-06497

PHYSICAL PROCESSES OF SEDIMENTATION, Reading Univ. (England). Sedimentology Research

New York, American Elsevier Publishing Comany, Inc, \$8.50, Earth Science Series No 1, 1970.

Descriptors: *Sedimentation, *Sediment transport, *Geomorphology, Sediments, Stratigraphy, Provenance, Sedimentary structures, Deposition (Sediments), Hydraulics, Open channel flow, Alluvial channels, Fluid mechanics, Hydrodynamics, Waves (Water), Winds, Dunes, Tides, Turbidity currents, Glaciers, Glacial drift, Sedimentology.

The properties of sedimentary deposits as related to the physical behavior of the moving fluids encountered naturally in the form of winds, rivers, tides and waves are examined. The material is intended for undergraduates in their second and third years who are relating geology to the physical background of sedimentation, particularly of clastic and bioclastic deposits. The book also serves as a springboard for graduate students who are beginning a training in research in sedimentology. Professional scientists outside the geological field will find the book a guide to fluid dynamics and loose-boundary hydraulics in both industrial and academic applications. Included is a sketch of the physical principles and concepts relevant to the application of fluid dynamics and loose-boundary hydraulics to sedimentation problems of geological interest. This sketch is followed by a more detailed treatment of sedimentation by the wind, in rivers, by waves and tides in shallow water, by turbidity or waves and titles in single water of chronic currents at great depth, and by glacier ice. In every case an attempt is made to view the processes quantitatively and to relate as closely as possible the sedimentary products with the processes. (Knapp-USGS) W71-06503

GEOLOGY, HYDROLOGY, AND GEOPHYSICS OF COLUMBIA SEDIMENTS IN THE MIDDLETOWN-ODESSA AREA, DELAWARE, Delaware Geological Survey, Newark. Nenad Spoljaric, and Kenneth D. Woodruff.

Available from NTIS as PB-198 345, \$3.00 in paper copy, \$0.95 in microfiche. Delaware Geological Survey Bulletin 13, August 1970. 156 p, 23 fig. 10 plate, 13 tab, 15 ref, 4 append. OWRR Project B-002-DEL (2).

Descriptors: *Hydrogeology, *Aquifers, *Delaware, *Alluvial channels, Alluvium, Stratigraphy, Transmissivity, Surveys, Geophysics, Electrical studies, Sediments, Water table, Water yield, Water levels, Water quality, Water sources, Channel morphology, Sedimentation.
Identifiers: Columbia aquifer (Del).

Columbia Formation sediments in the Middletown-Odessa area, Delaware, are composed of boulders, gravels, sands, silts and clays. Subsurface geology was interpreted on the basis of well-log data. The sediments were deposited in channels, flood plains, cut-off meanders, and levees. Twenty-two electri-cal resistivity soundings and two traverses were made in an attempt to determine the usefulness of the resistivity method in predicting Columbia thickness. Resistivity techniques appear to be useful in determining gross lithologies, but accurate depth solutions are not always possible. The Columbia Formation is the water-table aquifer in the Middletown-Odessa area and in most other parts of the State. Saturated thickness and water levels were determined in the study area by temporary installation of piezometers. The water-table was found to average about 30 feet below land surface in the central part of the study area. The transmissivity of the main paleochannel east of Middletown is about 40,000 gpd/ft. High iron content (1-2 mg/l) and low pH are common, and may present treatment problems. Extrapolation of Columbia aquifer coefficients from one area to another is not reliable and may produce erroneous results. (Knapp-USGS) W71-06657

SEDIMENT TRANSPORT IN RIVERS AND RESERVOIRS.

Corps of Engineers, Davis, Calif. Hydrologic Engineering Center.

Thomas, William A., Editor. Proceedings of a Seminar on Sediment Transport in Rivers and Reservoirs, Corps of Engineers Hydrologic Engineering Center, April 7-9, 1970, Davis, California, 1970. 145 p.

Descriptors: Conferences, *Sediment transport, *Sedimentation, *Sediment control, Erosion, River training, Sediment load, Computer programs, Model studies.

A U.S. Army Corps of Engineers Seminar was held to discuss sedimentation problems. Sediment problems encountered in water resource projects may be classified as either technical or institutional. Technical problems involve predicting the amount and location of sediment deposits and channel degradation, bed forms and their influence on flow depths, the effect of sediment on water quality, and the influence of sediment on the esthetic value of land surrounding reservoirs. Problems involving navigation requirements and bank stabilization structures require detailed knowledge of sediment movement and the resulting bed forms. In problems involving storage depletion in reservoirs and degradation downstream from dams, less detailed information is required. Because basic relationships governing the response of an alluvial stream to its water-sediment discharge are not clearly established, considerable engineering judgment is required to properly determine and solve sediment problems. Results from both analytical and hydraulic model studies should be interpreted only by experienced investigators. (See also W71-06676 thru W71-06686) (Knapp-HSGS) W71-06675

BASIC SEDIMENTATION PROBLEMS.

Corps of Engineers, St. Louis, Mo. Sediment Investigation Section.

In: Proceedings of a Seminar on Sediment Transport in Rivers and Reservoirs, Corps of Engineers Hydrologic Engineering Center, April 7-9, 1970, Davis, California, Paper No 1, 1970. 6 p.

Descriptors: *Sedimentation, *Bed load, *Reservoir silting, *Reviews, *Sediment transport, Research and development, Projects, Research facilities, Programs.

Research in bed load sedimentation is briefly reviewed. Substantial progress has been made in: knowledge of bed forms and their general relation-ships with the flow; appreciation of the effect of a heavy sediment load near the bed upon the distribution of sediment and velocity in stream flow; appreciation of the fact that there are really two zones of turbulent transport in a stream rather than a single zone; and appreciation of the role of secondary currents in the formation of a channel. For progress to be made toward scientific appraisal of the sediment problems involved in channel and reservoir design, it is necessary to encourage a policy of a review of work being done, to plan investigations so that they will be well coordinated, and to encourage active support of the work. (See also W71-06675) (Knapp-USGS) W71-06676

SEDIMENT YIELDS IN THE UPPER MISSISSIP-PI RIVER BASIN,

Corps of Engineers, Rock Island, Ill.

Frank J. Mack.

In: Proceedings of a Seminar on Sediment Transport in Rivers and Reservoirs, Corps of Engineers Hydrologic Engineering Center, April 7-9, 1970, Davis, California, Paper No 4, 1970. 10 p, 6 fig, 1

Descriptors: *Sediment yield, *Mississippi River, *Mississippi River Basin, Sediment load, Provenance, Geomorphology, Sedimentation rates, Erosion.

Identifiers: *Upper Mississippi River Basin.

The Upper Mississippi River Basin drains an area of 18,000 square miles. The drainage system includes portions of seven states in north-central United portions of seven states in north-central United States. The basin is relatively low-lying and gently to moderately rolling in character. This is the largest and most productive agricultural area in the United States. Sediment yield rates vary considerably throughout the basin. Generally the sediment yield is approximately 200 to 250 times greater in the extreme southern portion of the basin in comparison with the yields in the extreme northern part of the basin. As the size of the drainage area increases, the rate of sediment production per square mile decreases. This is the result of several factors. The chances that an intense storm will occur over the entire watershed become less and less as the watershed becomes larger. There is more variation in the rate of sediment production in smaller watersheds due to the fact that all physical factors vary more widely. The percentage of area of steep surface slopes with correspondingly high erosion rates decreases with the larger drainage area, which would tend to decrease the sediment yield per square mile of the larger basins. (See also W71-06675) (Knapp-USGS) W71-06677

SEDIMENT PROBLEMS IN ST. LOUIS HAR-

Corps of Engineers, Vicksburg, Miss. Hydraulic and Reservoir Regulation Section. James R. Tuttle.

In: Proceedings of a Seminar on Sediment Transport in Rivers and Reservoirs, Corps of Engineers Hydrologic Engineering Center, April 7-9, 1970, Davis, California, Paper No 7, 1970, 15 p, 4 fig, 3 tab, 4 ref, 2 map.

Descriptors: *Mississippi River, *Missouri River, *Sediment load, *Silting, *Harbors, Sedimentation, Deposition (Sediments), Hydraulic models, Model studies, Shallow water, Navigation. Identifiers: *St. Louis Harbor.

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The problem of inadequate depths at docks within the St. Louis Harbor apparently occurs in-frequently but is quite troublesome. During high flow years bed-material samples indicate median diameters ranging from 0.6 to 1.1 mm as compared to median diameters of about 0.3 mm during years of low flow. Sand rating curves developed at Hermann and St. Louis indicate that the Mississippi River at St. Louis is not capable of carrying the sand load delivered by the Missouri River. The respective annual ratings are 30 million tons at Hermann and 22 million tons at St. Louis. Data are not available in sufficient detail to make reasonable numerical analyses; therefore, a model study is being conducted by the Waterways Experiment Station on the St. Louis Harbor. (See also W71-06675) (Knapp-USGS) W71-06678

THE QUANTITY AND QUALITY OF SEDI-MENTS DEPOSITED IN CLEVELAND HARBOR AT CLEVELAND, OHIO,

Corps of Engineers, Chicago, Ill.

David L. Sveum.

In: Proceedings of a Seminar on Sediment Transport in Rivers and Reservoirs, Corps of Engineers Hydrologic Engineering Center, April 7-9, 1970, Davis, California, Paper No 8, 1970. 16 p, 5 plate,

Descriptors: *Sedimentation, *Silting, *Water pol-Descriptors: "Scalimentation, "Sitting, "Water pol-lution sources, *Lake Erie, *Ohio, Harbors, Provenance, Sediments, Sediment load, Water pol-lution effects, Dredging, Waste disposal, Landfills. Identifiers: Cleveland Harbor.

Erosion of the Cuyahoga River valley and its tributaries bring large quantities of sediment to the main stream, which are carried into Cleveland harbor. Erosion of areas disturbed by construction also produces sediment. Considerable quantities of municipal wastes, flue dust and other forms of industrial waste are deposited in the harbor. All of the materials which are deposited in the navigation channel must be removed by maintenance dredging. The materials so removed are considered to be grossly polluted, and continuation of the historical practice of disposing thereof by pumping in deep waters of Lake Erie, is considered to be inimical to the ecology of the lake. The average annual volume of the sediment inflow to Cleveland Harbor is about 1,242,000 cubic yards. The cheapest effective method of disposal, as an al-ternate to open lake disposal, is the use of diked containment areas near navigation projects.

Disposal by loading the material from the settling basin into trucks for transportation to landfill sites appears to have merit for this location and is being given further consideration. A pilot program included construction of pilot scale diked disposal areas at a few locations. (See also W71-06675) (Knapp-USGS) W71-06679

THE ROLE SEDIMENTS PLAY IN DETERMIN-ING THE QUALITY OF WATER,

Corps of Engineers, Omaha, Nebr. Hydro-Sediment Section.

Robert H. Livesey. In: Proceedings of a Seminar on Sediment Transport in Rivers and Reservoirs, Corps of Engineers Hydrologic Engineering Center, April 7-9, 1970, Davis, California, Paper No 9, 1970. 7 p, 1 plate.

Descriptors: *Sedimentation, *Water pollution effects, *Water pollution control, *Reviews, Sediment transport, Path of pollutants, Eutrophication. Identifiers: *Sedimentation-water quality relations.

Sediment-related pollution problems are reviewed by discussing some examples. In the waste assimilation capability of both suspended and streambed sediment, exchange processes play the key role, assisted by hydraulic conditions. Sedimentation affects the biological environment by changing the ability of the aquatic community to function adequately and vigorously. Sedimentation plays an important role in the eutrophication processes of lakes and reservoirs. Turbidity influences the depth of the photosynthetic region. Pollutants attached to sediment particles are not dispersed or transported as rapidly as dissolved pollutants; large concentra-tions may build up in bed deposits awaiting a significant change in water chemistry to release the concentration into solution, or such concentrations can be removed from the water environment by bu-rial in delta deposits. (See also W71-06675) (Knapp-USGS) W71-06680

THE INTERRELATIONSHIP BETWEEN WATER TEMPERATURE, BED CONFIGURATION, AND SEDIMENT CHARACTERISTICS IN THE MISSOURI RIVER,

Army Corps of Engineers, Omaha, Nebr. Warren J. Mellema.

Warren J. Mellema.
In: Proceedings of a Seminar on Sediment Transport in Rivers and Reservoirs, Corps of Engineers Hydrologic Engineering Center, April 7-9, 1970, Davis, California, Paper No 10, 1970. 7 p, 7 ref.

Descriptors: *Missouri River, *Sediment transport, *Suspended load, *Water temperature, *Viscosity, Turbidity, Deposition (Sediments), Stage-discharge relations, Discharge (Water), Suspension, Sedimentation.

Identifiers: Water temperature-sedimentation rela-

Research directed toward the development of prediction equations for the determination of sediment discharge in sand bed streams is reviewed. Most of the developments to date involve examination of results of detailed flume or laboratory investigations. Measurements obtained on streams where the discharge is held constant tend to dampen out many of the normal fluctuations found in most natural streams. Selected reaches of the Missouri River fit into this category, and field investigations are made on one of these reaches. A downward shift is observed in the stage-discharge relationship of about 1-1 1/2 to 2 feet in the fall months with little or no variation in discharge. Closely associated with this shift is a lower water temperature. A decrease in temperature increases viscosity and decreases particle fall velocity. If a sufficient number of particles in certain critical size ranges are available in the stream bed, a dramatic change in the total sediment load of the stream can occur. The presence of more fine sediment in the flow tends to further decrease the fall velocity of the coarser suspended particles. A major change in the water temperature can therefore have a very significant influence on a stream's ability to transport material in suspension. (See also W71-06675) (Knapp-USGS) W71-06681

SEDIMENTATION STUDIES FOR ROBERT S. KERR LOCK AND DAM, ARKANSAS RIVER

Corps of Engineers, Davis, Calif. Hydrologic En-

gineering Center. Howard O. Reese.

In: Proceedings of a Seminar on Sediment Transport in Rivers and Reservoirs, Corps of Engineers Hydrologic Engineering Center, April 7-9, 1970, Davis, California, Paper No 12, 1970. 14 p, 5 tab, 4 ref, 6 plate.

Descriptors: *Hydraulic models, *River training, *Stream stabilization, *Sediment control, Channel improvement, Sedimentation, Sediment transport, Dam construction, Model studies. Identifiers: *Sedimentation models.

The solution of major sedimentation problems played an important role in the planning, design, and construction of the Arkansas River multiplepurpose project. Investigations included the determination of natural and modified sediment loads, sediment deposits in channels and reservoirs and degradation below dams, and the prediction of modified channel regime. Sedimentation studies conducted for one individual reservoir project,

Robert S. Kerr Lock and Dam, of the Arkansas River multiple-purpose project are reviewed. The presence of coarse gravel in the bed hinders the rate of degradation, and in certain areas coarse gravel combined with the relatively nonmoving very coarse gravei should armor the bed. In those areas where a gravel control or armoring might occur, selective dredging may be necessary to expose the bed to flow which can cause an increase in the rate of degradation. This may have to be repeated several times to lower the bed to desired levels that would correspond with the 50-year weighted tailwater rating curve. It is not anticipated that major dredging should be necessary to lower the tailwater rating curve to the design level. (See also W71-06675) (Knapp-USGS) W71-06683

A DIGITAL MODEL FOR SIMULATING SEDI-MENT MOVEMENT IN A SHALLOW RESER-

Corps of Engineers, Davis, Calif. Hydrologic Engineering Center

For primary bibliographic entry see Field 06A. W71-06684

THE KANSAS CITY DISTRICT SUSPENDED SEDIMENT LOAD COMPUTER PROGRAM,

Corps of Engineers, Kansas City, Mo. Charles H. Sullivan.

In: Proceedings of a Seminar on Sediment Transport in Rivers and Reservoirs, Corps of Engineers Hydrologic Engineering Center, April 7-9, 1970, Davis, California, Paper No 14, 1970. 6 p, 9 fig, 2

Descriptors: *Computer programs, *Sediment discharge, *Data processing, Data collections, Hydrologic data, Sediment yield, Sedimentation, Discharge (Water), Suspended load, Sampling. Identifiers: *Suspended load computation.

A computer program was developed for computing daily suspended sediment loads. Lacking the intuition of the trained engineer, the computer results were found to be poor if daily average discharges were used. It was determined that much better accuracy could be developed by use of bihourly discharges. This suspended sediment program is operable and being used on a 301 RCA computer. The results available are within the reasonable range of accuracy. As additional stations are computed, possible additional analysis can be made for a predicting type of program. The operating time a predicting type of program. The operating time for computing stations for one year is 20 minutes. Normally, daily, monthly, and yearly suspended sediment loads are printed out. Bihourly load printout can be made when a specified c.f.s. value is exceeded during the day. This program is coded in Fortran II and can be obtained from the Kansas City District Office, Corps of Engineers. (See also W71-06675) (Knapp-USGS) W71-06685

CURRENT DUTCH PRACTICE FOR EVALUATING RIVER SEDIMENT TRANSPORT PROCESSES,

Corps of Engineers, St. Paul, Minn. Reservoir and Hydrologic Engineering Section.

Helmer O. Johnson.

In: Proceedings of a Seminar on Sediment Transport in Rivers and Reservoirs, Corps of Engineers Hydrologic Engineering Center, April 7-9, 1970, Davis, California, Paper No 15, 1970. 11 p, 5 fig, 6 ref, 2 append.

Descriptors: *Sediment transport, *Sedimentation, *Reviews, *Scour, Discharge (Water), Suspended load, Bed load, Surveys, Data processing, Channel morphology, River training. Identifiers: *Dominant discharge.

Man-made intervention in natural river systems will result in changes of sediment transport, scour and deposition. Knowledge of the mechanism of sediment transport will give insight into the expected

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results of artificial intervention and will decrease the chance of failure. This paper surveys the procedures relative to river processes and sediment transport which are currently being used in Europe and particularly in the Netherlands. The dominant discharge procedure enables engineers to determine the bed forming discharge of a river and also can serve as a guide in the design of river groynes (wing dams). Dutch engineers recommend that the height of groynes be governed by the dominant water level (dominant discharge) so as not to interfere with flood discharges. (See also W71-06675). (Knapp-USGS) W71-06686

DETERMINATION OF THE MANNING COEF-FICIENT FROM MEASURED BED ROUGHNESS IN NATURAL CHANNELS, Geological Survey, Washington, D.C.

J. T. Limerinos.

For sale by Superintendent of Documents, US Government Printing Office, Washington, DC. 20402, 35 cents. Geological Survey Water-Supply Paper 1898-B, 1970. 47 p, 9 fig, 5 tab, 27 ref.

Descriptors: *Sediments, *Streambeds, *Particle size, *Sediment distribution, *Mannings equation, Natural streams, Channel flow, Discharge coefficients, Roughness (Hydraulic), Mathematical studies, Streamflow, Flow measurement, Sediment transport, Alluvium, Alluvial channels, Hydraulics. Identifiers: *Streambed roughness, Bed material.

This report presents the results of a study to test the hypothesis that basic values of the Manning roughness coefficient of stream channels may be related to (1) some characteristic size of the streambed particles and to (2) the distribution of particle size. Fifty current-meter measurements of discharge and appropriate field surveys were made at 11 sites on California streams for the purpose of computing the roughness coefficient by the Manning formula. The test sites were selected to give a wide range in average size of bed material, and the discharge measurements and surveys were made at such times as to provide data covering a suitable range in stream depth. The characteristic bed-particle sizes used in the analyses were the 16-, 50- and 84-percentiles sizes as obtained from a cumulative frequency distribution of the diameters of randomly sampled surficial bed material. Separate distributions were computed for the minimum and intermediate values of the three diameters of a particle. No significant difference in reliability was found between the results obtained using minimum diameters and those obtained using intermediate diameters. The relations best fitting the field data for this study were obtained by using either a characteristic particle diameter equal to the 84percentile size or a diameter obtained by weighting three characteristic particle sizes. (Woodard-USGS) W71-06691

SLAMTRANSPORTUNDERSOKELSER NORSKE BRE-ELVER 1969 (SEDIMENT TRANSPORT STUDIES AT SELECTED GLACI-ER STREAMS IN NORWAY 1969) (Norwegian), Norwegian Water Resources and Electricity Board, Oslo.

Osio: G. Ostrem, T. Ziegler, and S. R. Ekman. Norges Vassdrags-Og Elektrisitetsvesen Report 6/70, Vassdragsdirektoratet Hydrologisk Avdeling, September 1970. 68 p, 29 fig, 20 ref.

Descriptors: *Sediment transport, *Streams, *Glaciers, Streamflow, Geology, Meteorology, Sedimentation, Sediment load, Suspension, Bed Jedinent Idaa, daspension, Jedical, Particle size, Melt water, Sampling, Methodology, Planning, Hydrologic data, Data collections, Water utilization, Hydroelectric power. Identifiers: *Glacier streams (Norway), *Norway.

The sediment transport studies undertaken at Norwegian glacier streams is a joint venture between the Norwegian Water Resources and Electricity Board and the Department of Physical Geography

at Stockholm University. The aim of the investigations is to gain knowledge about the magnitudes and variations of sediment transport in glacier streams including the study of deposition of such material. The data has an important bearing on the planning of the future hydro-electric projects utilizing glacier meltwater streams and also for studying glacier erosion which the transported sediments are a result of. In 1969 an attempt was made to determine the bed load transport from Nigardsbreen by trapping all the coarse material in a constructed steel-net. A description of this experiment is given. Water samples were collected 2-5 times daily at one or more observation sites along the glacier streams during a field period. During flood conditions samples were taken hourly. A synopsis of the results from the investigations in 1969 are presented together with the results of studies from previous years. The table demonstrates clearly the variations in the volumes of transported sediments that exist between the individual glaciers and fluctuations in the volumes of transport for one and the same glacier from year to year are revealed. (Woodard-USGS) W71-06694

RIVER-COAST INTERACTION: LABORATORY

SIMULATION, Florida Univ., Gainesville. Dept. of Coastal and Oceanographic Engineering.

Omar H. Shemdin.

ASCE Proceedings, Journal of the Waterways, Harbors and Coastal Engineering Division, Vol 96, No WW 4, p 755-766, November 1970. 12 p, 11 fig, 2 ref, append.

Descriptors: *Hydraulic models, *Sedimentation, *Sand bars, *Backwater, Coastal engineering, Deposition (Sediments), Water levels, Sedimentary structures, Erosion, Floods, Hydraulic similitude, Shoals.

Identifiers: *River coast interactions.

The flow of a river into the ocean is often obstructed by a sand bar at the river mouth. The interaction of a river with the coast can be simulated in a hydraulic model with a movable bed. Use was made of the equation of continuity of sediment flow to arrive at similarity relationships. The method was used successfully for the Yaquez River in Puerto Rico. Water surface elevation in the river rises because of the obstruction of the bar at the river mouth. The highest water elevation occurs before the peak flow arrives at the mouth. Coastal structures were tested to minimize the water elevation. The method offers a useful coastal engineering tool but work is needed to include the influence of waves. (Knapp-USGS) W71-06697

WATER WAVES GENERATED BY LAND-SLIDES,

Asian Inst. of Tech., Bangkok (Thailand). For primary bibliographic entry see Field 02E. W71-06698

EFFECT OF STRAIN HISTORY ON LIQUEFAC-

TION OF SAND, British Columbia Univ., Vancouver. Dept. of Applied Science; British Columbia Univ., Vancouver. Dept. of Civil Engineering; and Partner, Cook, Pickering and Doyle Ltd., Vancouver. For primary bibliographic entry see Field 02G. W71-06700

A REVIEW OF THE WORK OF THE JAROSLAV CERNI INSTITUTE FOR THE YEAR 1968.

Institut za Vodoprivredu Jaroslav Cerni, Belgrade (Yugoslavia). For primary bibliographic entry see Field 02E. W71-06704

BULK DENSITY OF SEDIMENTS IN RIVER RESERVOIRS,

V. Miloradov.

Transactions Institute for Development of Water Resources, 'Jaroslav Cerni,' Vol 14, No 45, p 5-12, 1969. 8 p, 4 fig, 3 tab, 8 ref.

Descriptors: *Bulk density, *Sedimentation, *Reservoir silting, Sediment yield, Silts, Sediment transport, Reviews, Sampling, Surveys. Identifiers: *Yugoslavia, *Danube River.

For forecasting sedimentation in newly designed reservoirs, equations are given in terms of the bulk density of sediment. However, bulk density cannot be measured on sediments from the river for which the reservoir is designed because they usually do not correspond to the sediments that will be deposited once the reservoir is constructed. To assess some criteria for the choice of bulk density in calculations for the Derdap Power Plant on the Danube, data from the literature was reviewed and new data were collected in Yugoslav rivers and reservoirs. (See also W71-06704) (Knapp-USGS) W71-06706

NOTES ON SEDIMENTATION ACTIVITIES, CALENDAR YEAR 1969.
Bureau of Reclamation, Washington, D.C.

Water Resources Council, Sedimentation Committee Annual Report, 1970. 207 p, 1 fig, 4 tab, ap-

Descriptors: *Sedimentation, *Documentation, *Publications, *United States, Programs, Projects, Bibliographies, Sediment transport, Streams, Reservoirs, Lakes, Sediment yield, Sedimentation rates, Particle size, Erosion, Sedimentology. Identifiers: *Sedimentation activities (USA), Suspended sediment.

This report is a digest of information furnished by all Federal agencies conducting sedimentation investigations on work in progress or planned, important findings, new methods, new publications, laboratory and other research activities, and other pertinent information. The material has been organized by major drainage regions in the conterminous United States, Alaska, Hawaii, Puerto Rico, and Okinawa. Other major headings include Foreign Activities and Laboratory and Other Research Activities. An excerpt from the Catalog of Information on Water Data, Index to Water Quality Stations, 1970 edition, compiled by the Geological Survey, Office of Water Data Coordination, is included as Appendix A. This excerpt is a list, as of January 1970, of long-term water quality sites at which sediment data have been collected. Appendix B is a listing of agency addresses by de-partments where additional information on agency activities can be obtained. (Woodard-USGS) W71-06720

CONTINENTAL SHELF AND UPPER SLOPE SEDIMENTS OFF PORTUGESE GUINEA, GUINEA, AND SIERRA LEONE,

Rhode Island Univ., Kingston. Graduate School of Oceanography; and Woods Hole Oceanographic Institution, Mass.

Robert L. McMaster, John D. Milliman, and Asaf Ashraf.

Journal of Sedimentary Petrology, Vol 41, No 1, March 1971, p 150-158. 9 p, 5 fig, 20 ref. ONR Contract N00014-68-A-0215-0003.

Descriptors: *Bottom sediments, *Provenance, *Continental shelf, *Continental slope, *Sedimentation, Stratigraphy, Deposition (Sediments), Sediment transport, Waves (Water), Tides, Tidal effects, Deltas. Identifiers: *Africa.

Sediments on the continental shelf off Portuguese Guinea, Guinea, and Sierra Leone are mainly terrigenous, and have been stream derived. Except for

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a lobe of terrigenous material extending seaward from the Orango Delta, most sediments on the outer shelf and upper slope are rich in shallow-water biogenic carbonate and weathered glauconite, suggesting severe restriction in the offshore transport of detrital sediments, both at present and during the last low stand of sea level. In general the surface sediments are medium to fine sands. moderately to moderately well sorted and negatively skewed. For the most part these sands accumulated during the Pleistocene. However, the Holocene transgression and accompanying environmental processes have modified these sediments so that distinctive grain size parameters that characterized their original depositional environ-ments can no longer be detected. Silts and clays on the Bissagos Delta front, derived from the Cacheo and Geba Rivers and probably the Casamance River, are the only sediments presently accumulating on the middle or outer shelf in this area. Coastal and tidal currents may have moved some of this sediment toward the south, where it has been funneled locally into the deep sea. (Knapp-USGS)

PALEOFLOW CHARACTERISTICS OF A LATE CRETACEOUS RIVER IN UTAH FROM ANALYSIS OF SEDIMENTARY STRUCTURES IN THE FERRON SANDSTONE,

Bucknell Univ., Lewisburg, Pa. Dept. of Geology

and Geography. Edward Cotter.

Journal of Sedimentary Petrology, Vol 41, No 1, p 129-138, March 1971. 10 p, 5 fig, 46 ref.

Descriptors: *Paleohydrology, *Alluvial channels, *Sedimentary structures, *Stratigraphy, Bed load, Suspended load, Sand waves, Dunes, Streamflow, Mannings equation, Sandstones, Petrofabrics,

Identifiers: Ferron sandstone (Utah).

Interpretation of sedimentary sturctures and detailed stratigraphic relations of the fluvial facies of the Upper Cretaceous Ferron Sandstone in the Castle Valley in east-central Utah permits reasonable reconstruction of many parameters of a Late Cretaceous alluvial system. The width and depth of flow of the ancient Ferron River were estimated from the geometry of preserved sedimentary structures, and the type of sediment transported by the river was determined by studying the sandstone texture. Various relationships of modern streams empirically derived by Schumm are used to estimate channel sinuosity, meander length, mean annual discharge, mean annual flood, channel slope, and flow velocity. Values derived for the slope and velocity are supported by other indirect methods based on the Manning equation. It appears likely that the Late Cretaceous Ferron River was about 300 feet wide and 25 feet deep, and that it was highly sinuous, with meander lengths of 2,500 to 4,100 feet. As the 200-mile-long river drained an area to the southwest of 6,000 to 8,000 square miles, it had a mean annual discharge of approximately 6,000 to 7,000 cubic feet per second and a mean annual flood of about 22,000 cfs. Although only 2 percent of the total river load was bedload, the flow velocity of between 2.0 and 4.6 feet per second in the upper part of the lower flow regime caused the fine- to medium-grained sand to be in a dune bed configuration. (Knapp-USGS)

WAVE EFFECTIVENESS AT THE SEA BED AND ITS RELATIONSHIP TO BED-FORMS AND DEPOSITION OF MUD, University of East Anglia, Norwich (England). School of Environmental Sciences.

I. N. McCave.

Journal of Sedimentary Petrology, Vol 41, No 1, p 89-96, March 1971. 8 p, 7 fig, 1 tab, 25 ref.

Descriptors: *Waves (Water), *Bottom sediments, *Sediment transport, *Suspended load, *Muds, Sedimentation, Turbulence, Currents (Water). Identifiers: *Wave effectiveness, North Sea.

A wave effectiveness parameter is defined as the product of theoretical instantaneous sediment product of theoretical installations seeming, transport rate times frequency, for wave action at the sea bed. High values of this parameter are found in waters shallower than 18 m. in the southern North Sea and are related to absence of sand waves at these depths. Mud deposition occurs in certain shallow areas of the southern North Sea where the concentration of suspended sediment is high. Farther offshore, where suspended sediment concentration is low and wave activity moderate no mud deposits are found. With increasing depth, more mud is found in the bottom sediment. In the Celtic Sea the wave effectiveness parameter has the same value at 73 m. as it does in the North Sea at 30 m. This is close to the sand/mud boundary in the bottom sediments of both areas. Wave activity is only one factor--others being suspended sediment concentration and cirrent velocity--influencing deposition of mud. Some ancient mudstone could have been deposited in shallow waters off exposed coasts. (Knapp-USGS) W71-06990

PSEUDO-PLANAR
PRODUCED BY VERY LOW AMPLITUDE
SAND WAVES,
Illinois Univ., Chicago.
Norman D. Smith.

Journal of Sedimentary Petrology, Vol 41, No 1, p 69-73, March 1971. 5 p, 6 fig, 19 ref.

Descriptors: *Sedimentary structures, waves, Ripple marks, Stratigraphy, Alluvial chan-nels, Bed load, Sediment transport, Dunes. Identifiers: Platte River (Nebr).

Thin sand sheets with downstream foresets form in very shallow depths in the Platte River and resemvery shallow depths in the Platte River and resemble small sand waves. They produce internal horizontal stratification which is superficially similar to upper flow regime plane bed deposits except that the grains are differentiated into alternating coarse and fine laminations by sorting processes at the foreset. A 12-inch bed of horizontal laminae exposed in a river bank formed by accretion of low amplitude sand waves on a floodplain during slowly increasing flood stages. (Knapp-USGS) W71-06991

QUARTZ GRAIN ORIENTATIONS -- 1 (THE PHOTOMETRIC METHOD),

Mobil Research and Development Corp., Dallas, Tex. Field Research Lab.

R. F. Sippel.

Journal of Sedimentary Petrology, Vol 41, No 1, p 38-59, March 1971. 22 p, 23 fig, 1 tab, 15 ref.

Descriptors: *Sedimentary petrology, *Microscopy, *Sedimentary structures, *Petrofabrics, *Sandstones, Particle shape, Particle size, Petrology, Sedimentary rocks, Petrography. Identifiers: *Particle orientation (Sediments).

Among several rapid methods which have been suggested for measuring sandstone grain orientation, the photometric method has much to recommend it. Crystallographic methods are applicable except in very rare instances, and have unique advantages compared to the particulate methods. This paper employs the Jones Calculus, a powerful method for polarized light calculations. With its help a quantitative theory of the photometer is presented. An optimum form of the photometer is derived and compared with the form originally suggested. Photometer action is simulated in the computer, and the instrument is tested for ability to analyze assumed three-dimensional distributions of quartz grain c axes. Effect of porosity, thin section thickness, inclination of the preferred direction, and strength of preferred orientation are all evaluated for each instrument. (Knapp-USGS) W71-06992

MEASUREMENT OF C INTERCEPTS IN LOOSE SAND GRAINS BY OPTICAL HEIGHT, Idaho State Univ., Pocatello. William B. Wadsworth.

Journal of Sedimentary Petrology, Vol 41, No 1, p 30-37, March 1971, 8 p, 5 fig. 1 tab, 25 ref.

Descriptors: *Particle shape, *Microscopy, *Measurement, Sedimentology, Shape, Analytical techniques, Particle size, Statistics, Statistical methods, Variability.
Identifiers: *Particle shape determination.

A procedure for directly measuring the shortest axis of an individual particle by focusing a microscope successively on its mounting surface and then on its highest point is found to be feasible. This distance, as read from a calibrated fine-focus drum, is both highly accurate and sufficiently precise for most purposes, though an easily determined correction factor may be required for built-in bias of the focus calibration. Comparison of 200 optical height measurements on 40 grains with paired observations derived by eyepiece micrometics. ter demonstrates an identity of mean values. Optiter demonstrates an identity of mean values. Opti-cal height data are nearly three times less precise; nevertheless, roughly 170 of 200 observations occur within six percent of their group mean values throughout the sand size range. After initial calibration of the microscope, no preparatory stages in grain mounting or equipment manufac-ture are required; the routine petrographic microscope and accessories are sufficient for opti-cal height determinations. The result is a procedure cal height determinations. The result is a procedure which permits essentially simultaneous measurement of all three principal grain diameters, giving immediate access to three-dimensional grain size and shape information and the advantage of direct measurement. (Knapp-USGS) W71-06994

THE RELATIONSHIP BETWEEN SPHERE SIZE AND SETTLING VELOCITY,

Northwestern Univ., Evanston, Ill. Dept. of Geological Sciences.
Ronald J. Gibbs, Martin D. Mathews, and David A.

Journal of Sedimentary Petrology, Vol 41, No 1, p 7-18, March 1971. 12 p, 1 fig, 6 tab, 18 ref.

Descriptors: *Sedimentation, *Settling velocity, *Particle size, Viscosity, Sediment transport, Deposition (Sediments), Instrumentation, Equations, Laboratory tests, Stokes law, Density. Identifiers: *Settling tubes.

The settling velocities in water of 216 glass spheres ranging in size from 50 to 5000 microns in diameter were determined. The size, density, and shape of these spheres were accurately known. All timing precisions were better than 1/2% and the combined precision (size, shape, density, timing, etc) of the velocity measurements was less than 2% at a 95% confidence level. Based on this data an empirical equation was derived to give the relationship between sphere size and settling velocity. The range of usefulness of the equation includes spheres from 0.1 micron to 6 mm diameter and, with correction factors, is extended to 50 mm spheres. Tables are presented relating various sphere diameters, water temperatures, sphere densities, and fluid salinities. The equation may be used as a basis of standardization of settling tube data and as a basis for determining the sedimenta-tion diameter. (Knapp-USGS) W71-06995

CASE-HARDENING OF CARBONATE ALLUVI-UM AND COLLUVIUM, SPRING MOUNTAINS, NEVADA,

Pennsylvania State Univ., University Park. Dept. of Geology and Geophysics.

Laurence H. Lattman, and Elliott M. Simonberg. Journal of Sedimentary Petrology, Vol 41, No 1, p 274-281, Mar 1971. 8 p, 9 fig, 2 ref. AF Cambridge Lab. Contract No F 19628-68-C-0136.

Descriptors: *Alluvium, *Water chemistry, *Diagenesis, *Seepage, *Leaching, Calcite, Calcium carbonate, Limestones, Recharge, Groundwater movement, Nevada, Chemical precipitation, Caliche.

Identifiers: Spring Mountains (Nevada).

Group 2J—Erosion and Sedimentation

Case-hardening of vertical faces of alluvium and colluvium in, and flanking, the Spring Mountains, Nevada, begins within one or two years after expo-sure and may proceed to the extent that samples break through clasts. The alluvium and colluvium consist primarily of carbonates, and the cementation which causes the case-hardening appears to be due to solution of the sand-sized and finer carbonate fractions and subsequent deposition of calcite. Above present drainage channels the case-hardening seems to be caused by surface runoff, and the rapidity and degree of cementation is controlled by the texture of layers and lenses within the trolled by the texture of layers and leases within the colluvium and alluvium. Along the present drainage, the case-hardening appears to be due to influent seepage from the streams during spring runoff or during infrequent summer showers and is little affected by texture. (Knapp-USGS)

SOURCE AND MIXING OF INSOLUBLE CLAY MINERALS IN A SHALLOW WATER CARBONATE ENVIRONMENT - FLORIDA BAY,

University of South Florida, Tampa. Dept. of

For primary bibliographic entry see Field 02L. W71-06997

LIFT FORCES ON SUSPENDED SEDIMENT PARTICLES IN LAMINAR FLOW: EXPERI-MENTS AND SEDIMENTOLOGICAL IN-TERPRETATION,

Massachusetts Inst. of Tech., Cambridge.

John B. Southard.

Journal of Sedimentary Petrology, Vol 41, No 1, p 320-324, March 1971. 5 p, 1 fig, 6 ref. ONR Contract Nonr 1841 (74)-NR083-157.

Descriptors: *Sediment transport, *Laminar flow, *Bed load, *Tractive forces, Flow, Sedimentation, Alluvial channels.

Identifiers: Lift forces (Sedimentation).

A sphere carried by laminar flow past a planar boundary is affected by a force away from the boundary. The sedimentological implications of this effect, both for transportation of coarse sedi-ment in strong turbulent flows and for deposition of fine sediments from oceanic bottom currents, were explored by estimating the lift force on small, nearly neutrally buoyant spheres suspended in laminar flow in a laboratory flume and evaluating how closely this models the lift force in the natural flows. This lift-force effect is probably not important in natural sedimentary processes. (Knapp-USGS) W71-06998

A TEST OF VALIDITY OF QUARTZ GRAIN ORIENTATION AS A PALEOCURRENT AND PALEOENVIRONMENTAL INDICATOR,

Guelph Univ. (Ontario). Dept. of Soil Science. I. P. Martini.

Journal of Sedimentary Petrology, Vol 41, No 1, p 60-68, March 1971. 9 p, 6 fig, 2 tab, 20 ref.

Descriptors: *Sedimentary structures, *Paleohydrology, *Sedimentation, *Petrofabrics, *Microscopy, Sandstones, Particle shape, Particle size, Petrology, Sedimentary rocks, Petrography. Identifiers: *Particle orientation (Sediments).

Analysis of quartz grain orientation in a set of 261 thin sections obtained from the Thorold and Grim-sby Sandstone (Silurian, S.W. Ontario and New York State) indicates that: (1) The number of measurements needed for a petrographic analysis of grain orientation varies from 50-100 in thin sections cut perpendicular to the depositional surface, to 150-250 in thin sections cut parallel to the depositional surface; (2) preferred grain imbrica-tions are encountered in the vast majority of the samples examined. Vertical thin sections cut parallel to the vector mean of the H-grain orientation show a tendency to have an average imbrication value significantly different from zero, hence usable for paleocurrent determinations. Grain orientation distributions are useful in sedimentological paleoenvironmental reconstructions. The grain imbrication populations measured in apparently massive beds are a mixture of grain imbrications and of H-grain orientations. The vector means of the hgrain orientation of the massive beds can be utilized as valid line of movement data. (Knapp-USGS) W71-06999

MIXING AT TURBIDITY CURRENT HEADS, AND ITS GEOLOGICAL IMPLICATIONS,

Reading Univ. (England). Sedimentology Research

J. R. L. Allen.

Journal of Sedimentary Petrology, Vol 41, No 1, p 97-113, March 1971. 17 p, 8 fig, 1 tab, 35 ref.

Descriptors: *Sediment transport, *Mixing, *Turbidity currents, *Sedimentary structures, Bottom sediments, Bed load, Suspended load, Mathematical studies, Variability, Turbidity, Turbulence, Turbulent flow, Density currents, Continental slope. Identifiers: Gravity currents.

The shape of the head of a turbidity current is consistent with an inflow of the ambient medium into the current along clefts and tunnels regularly spaced along and back from the overhanging front of the head. When the rate of inflow of the ambient medium into the head is expressed mathematically, it is shown that the bed shear stresses exerted in the region of the head vary transversely across the region with a spatial periodicity. The deduced force structure of the head region explains the occur-rence on turbidite soles of regular bands or clusters of flute marks aligned parallel with flow. The nearbed flow in the head is strongly three-dimensional, and this may explain the commonly observed nonparallelism of the sole markings observed on single pedding surfaces. The rates of inflow of the ambient medium into the head are found to be large enough to account for the density reduction necessary for the transformation of a liquified sediment slump into a turbidity current in a journey down the continental slope and upper rise. (Knapp-USGS) W71-07000

RELATIONSHIP BETWEEN GRAIN PARAMETER DISTRIBUTION AND CURRENT PATTERNS IN THE GIRONDE ESTUARY (FRANCE),

Inst. of Gelogie du Bassin d'Aquitaine, Facultes des Sciences, Bordeaux, France.

For primary bibliographic entry see Field 02L. W71-07001

PARTICLE SHAPE: CLASSIFICATION OF THICKNESS USING SLOTTED SCREENS,

Gulf Research and Development Co., Pittsburgh,

John C. Ludwick.

Journal of Sedimentary Petrology, Vol 41, No 1, p 19-29, March 1971. 11 p, 5 fig, 4 tab, 23 ref.

Descriptors: *Particle shape, *Sieve analysis, *Sieves, Shape, Analytical techniques, Separation techniques, Measurement, Particle size, Settling

Identifiers: *Particle shape determination.

A shape classification of sand particles according to thickness is obtained by sieving a sediment sample through a nest of several screens with slotted openings, the widths of which are smaller in each subjacent screen. The sample is first sieved through a pair of round-holed screens, the openings of which are nearly the same. This produces a subsample narrowly limited in particle size. The shape distribution in the sediment fraction obtained through use of the round-holed screens is unbiased. The distributions of particle thickness in the individual slotted screen fractions are bell-shaped, skewed depending on location relative to the modal class, and overlapping to a predictable degree. In using the method, slotted screen fraction weights

are converted to number of particles per fraction. These particles are distributed keeping the areas under the individual distributions proportional to the corresponding number of particles. The num-bers of particles per standard class interval of particle thickness are summed over the different distributions to yield the desired distribution of relative particle thickness for the sample. (Knapp-W71-07002

AREAL SORTING OF BED-LOAD MATERIAL: THE HYPOTHESIS OF VELOCITY REVERSAL, Purdue Univ., Lafayette, Ind. Dept. Geosciences.

Edward A. Keller.

Geological Society of America Bulletin, Vol 82, No 3, p 753-756, March 1971. 4 p, 1 fig, 5 ref.

Descriptors: *Sediment transport, *Bed load, *Alluvial channels, *Particle size, *Channel morphology, Sedimentation, Bottom sediments, Deposition (Sediments), Streamflow, State-discharge relations, Current meters, California, Velocity. Identifiers: *Sorting (Sedimentation).

The hypothesis of velocity reversal seems adequate to explain the areal sorting of channel material, that is, relatively large material in riffles and finer material in pools. The hypothesis is based primarily on the observation that with increasing discharge the average bottom velocity of a pool increases faster than that of a riffle until at relatively high flow the average bottom velocity of the pool exceeds that of a riffle. The areal sorting produced by the velocity reversal occurs at flows of moderate frequency. (Knapp-USGS) W71-07009

GEOMORPHOLOGY OF THE FILDES PENIN-SULA ON KING GEORGE (WATERLOO) ISLAND,

USSR Arctic and Antarctic Scientific Research Inst., Leningrad, Dept. of Geographical Sciences. V. V. Zamoruyev.

Translated from Informatsionnyi Byulleten' Sovetskoi Antarticheskoi Ekspeditsii, No 71, p 36, 1968. Soviet Antarctic Expedition Information Bulletin, Vol 7, No 3, p 197-198, January 1971. 2 p, 2 ref.

Descriptors: *Geomorphology, *Antarctic, Erosion, Topography, Lakes, Streams, Infiltration, Scour, Glaciers, Solifluction, Mass wasting, Polar regions, Cold regions.

Identifiers: *Fildes Peninsula (Antarctica), *An-

The Fildes Peninsula is the southwestern tip of Waterloo Island in the South Shetland Island group. The peninsula extends 10 km from the southwest to the northeast and is 2.5-3 km wide. The coastline is dissected by numerous inlets and capes, the most important of which is Ardley Peninsula on the east coast. Most of Fildes Peninsula is free of ice and it does not differ essentially from the 'oases' on the Antarctic continent. The edge of the ice dome, covering Waterloo Island, crosses the northern part of Fildes Peninsula. The ice-free part of Fildes Peninsula is hilly with absolute elevations of up to 150 m. The configurations of large relief forms are probably determined by fractures and tectonically weakened zones. Small lakes, found in the depressions between hills, total 13. The largest of these measures 500 x 250 m. According to preliminary data, the depth of many lakes is at least 5-7 m. The present leading relief-forming processes are physical weathering and solifluction. The drainage network is poorly developed. Because of slow and irregular snow melting and the nature of the loose deposits, most of the water does not form streams, but saturates the accumulations of weathering products and promotes the development of solifluction. The existing streamlets are small and their channels are entrenched only several tens of centimeters. They frequently lack a permanent channel and develop in the form of many small rivulets flowing along the

Chemical Processes—Group 2K

foot of the solifluction trains. Sometimes, the small streams disappear in the solifluction deposits. Traces of a sea level higher than that now existing occur in many coastal areas. (Knapp-USGS) W71-07013

CONTINENTAL SABKHA IN ARAVA VALLEY BETWEEN DEAD SEA AND RED SEA: SIGNIFICANCE FOR ORIGIN OF EVAPORITES, Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of

Abraham J. Amiel, and Gerald M. Friedman.

The American Association of Petroleum Geologists Bulletin, Vol 55, No 4, p 581-592, April 1971, 12 p, 12 fig, 3 tab, 35 ref.

*Sedimentation, *Deserts, **Water chemistry, **Cansum, Descriptors: *Sedimental lakes, Evaporation, Groundwater movement, Gypsum, Carbonates, Sulfates, Chemical precipitation, Salts, Chlorides, Stratigraphy, Alluvium, Seepage, Water table.

Identifiers: *Sinai *Sabkhas. Peninsula. *Evaporites.

The Yotvata Sabkha, a continental sabkha having an area of 45 sq km, fills the entire Arava Valley, in the Sinai Peninsula. The climate is one of the most arid in the world. Short, ephemeral streams (wadis), prevented by alluvial fans from reaching the Gulf of Aqaba, provide water that seeps into the soil, thus keeping the water table close to the surface. The capillary fringe above this water table is at the floor of the sabkha. Three distinct zones exist in the sabkha: (1) the central barren zone, (2) the transitional zone, and (3) the outer vegetated zone with halophytic vegetation. Depths to groundwater range from 90 cm in the central barren zone to more than 3 m in the outer vegetated zone. Chlorinity values in the groundwater are highest in the central barren zone (up to 20%) and decrease toward the transitional and outer vegetated zones (1%); a sharp drop occurs near the contact between the central barren zone and transitional zone. The sulfate concentration in the groundwater is greatest in the transitional zone and decreases both toward the central barren zone and the outer vegetated zone. The Mg/Ca ratio of the ground-water parallels the trend in the sulfate concentration. Gypsum is the principal authigenic mineral in the transitional and outer vegetated zones, whereas halite predominates in the central barren zone. (K-napp-USGS) W71-07024

RECOGNITION OF BARRIER ENVIRON-

Missouri Univ., Columbia; and Southern Illinois Univ., Carbondale; and Texas A and M Univ., College Station. Dept. of Geology

David K. Davies, Frank G. Ethridge, and Robert R. Berg.

The American Association of Petroleum Geologists Bulletin, Vol 55, No 4, p 550-565, April 1971. 16 p, 15 fig, 3 tab, 32 ref.

Descriptors: *Sedimentation, *Beaches, *Sand Descriptors: "Sedimentation, "Beaches, "Saind bars, *Dunes, *Sedimentary structures, Geomorphology, Waves (Water), Deposition (Sediments), Shoals, Coasts, Sands. Identifiers: *Coastal barriers.

The vertical succession of sedimentary structures and textures at Galveston Barrier Island, Texas, is identical with vertical successions in two ancient barrier complexes, one in the lower Cretaceous of Montana and the other in the Lower Jurassic of England. Within both Holocene and ancient examples, there is a gradation upward from irregular interlaminations of siltstone and claystone at the base, through burrowed and generally structureless sandstone, to low-angle and microtrough crosslaminated sandstone, terminating (in two of the examples) in structureless and rooted sandstone. This sequence represents deposition in lower shoreface, middle shoreface, upper shoreface-beach, and eolian environments, respectively. Analyses of quartz size and content of the Holocene and ancient barriers yield textural and compositional parameters that are environmentally sensitive. Plots of these parameters demonstrate that each of the environments may be distinguished on the basis of thin-section analyses. Consequently, full diameter cores may not be necessary for precise environmental interpretation in the subsurface. (Knapp-W71-07025

MEASUREMENT OF SHEAR STRESS AND ROUGHNESS LENGTH ON A BEACH,

Louisiana State Univ., Baton Rouge. Coastal Stu-

Shih-Ang Hsu.

Journal of Geophysical Research, Vol 76, No 12, p 2880-2885, April 20, 1971. 6 p, 4 fig, 2 tab, 18 ref. ONR Contract N00014-69-A-0211-0003, NR 388

Descriptors: *Beaches, *Dunes, *Roughness coefficient, *Shear drag, *Winds, Wind erosion, Aeolian soils, Wind pressure, Air-earth interfaces, Boundary processes, Flow resistance, Shear, Sur-

Identifiers: Roughness (Aerodynamic).

Measurements of surface shearing stress and aerodynamic roughness length on a beach were made by simultaneous temperature- and windprofile methods in the following three areas of the beach slope on the Gulf of Mexico coast near Fort Walton Beach, Florida: the swash zone, the midforeshore, and the area near the berm scarp. Under adiabatic and onshore wind conditions, the swash zone is approximately 100 times smoother than the mid-foreshore and 500 times smoother than the area near the berm scarp; the shear stress is approximately 2.5 and 3.5 times larger at 10 m and 20 m fetch downwind, respectively, from the swash zone. (Knapp-USGS) W71-07028

A TIME SERIES FROM THE BEACH EN-VIRONMENT-II,

Virginia Inst. of Marine Science, Gloucester Point. W. Harrison, and L. E. Fausak. Virginia Institute of Marine Science Data Report

No 7, December 1970. 96 p. 4 fig, 1 tab, 15 ref, 6 append. ONR Contract Nonr-N00014-70-C-000A. ONR Task No NR 388-097.

Descriptors: *Beaches, *Environmental effects, *Time series analysis, *Coasts, *Virginia, Ocean waves, Marine geology, Water table, Elevation, Tides, Rainfall, Pressure, Water levels, Water wells, Oceans, Shores, Slopes, Mathematical studies, Hydrologic data, Data collections, Groundwater, Bedrock, Geomorphology, Erosion. Identifiers: *Virginia Beach.

Beach variables were sampled during a 30-day period in August and September, 1969, at Virginia Beach, Virginia. The purpose was to investigate the water table of a marine beach and to clarify the interaction of the water table and several process variables of the beach-ocean-atmosphere system. This report describes the methods of measurement and tabulates the values obtained for the following variables: breaker height, breaker period, trough-to-bottom depth in front of a breaking wave, breaker steepness, breaker power, the limit of swash run-up, the outcrop of the water table on the foreshore, slope of the foreshore, water table elevation, beach elevation, barometric pressure, rainfall, and still-water level. (Woodard-USGS) W71-07047

AND **CEMENTED** FLORIDA BEACHES WATER-TABLE ROCKS,

Louisiana State Univ., Baton Rouge. Coastal Studies Inst.

Richard J. Russell.

Louisiana State University Coastal Studies Institute Technical Report 88, October 30, 1970. 53 p, 2 fig, 31 photo, 6 tab, 44 ref. ONR Contract N00014-69-A-0211-0003. Project NR 388 002.

Descriptors: *Diagnesis, *Chemical precipitation, *Marine geology, *Beaches, *Florida, Water tables, Rock properties, Cohesion, Atlantic Ocean, Gulf of Mexico, Coasts, Geology, Mineralogy,

Stratigraphy.
Identifiers: *Beach rock cementation, *Florida

In October 1969 Florida beaches between Cedar Key and Dry Tortugas, on the coast of the Gulf of Mexico, and beaches along the Atlantic Ocean as far north as Anastasia Island (St. Augustine), were investigated in a reconnaissance study of composition and indications of cementation associated with their water tables. In all cases cementation was restricted to the zone of water-table fluctuation. There is excellent beach rock on Loggerhead Key (Dry Tortugas) and on Middle Cape (Cape Sable), good beach rock on East Cape (Cape Sable), and water-table rock on Grassy Key (east of Marathon). Other occurrences probably exist south of a line extending from the mouth of Shark River to the coast somewhat south of Homestead. Reported localities farther north on the Atlantic Coast, most of which are given in terms of generalizations, appear to be misidentifications resulting from confusion with outcrops of the Anastasia formation, many of which are in positions where beach rock might be suspected. (Woodard-USGS)

2K. Chemical Processes

TRITIUM LOSS FROM WATER EXPOSED TO THE ATMOSPHERE,

Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.

J. Henry Horton, John C. Corey, and Richard M. Wallace

Environmental Science and Technology, Vol 5, No 4, p 338-343, April 1971. 6 p, 10 fig, 1 tab, 7 ref.

Descriptors: *Tritium, *Evaporation, *Surface waters, *Atmosphere, Laboratory tests, Mathematical studies, Equations, Streamflow, Streamflow, Watersheds (Basins), Meteorology, Air-water interfaces

Identifiers: *Tritium loss.

Equations describing the loss of tritium as HTO from water into air and the gain of HTO in water when the overlying water vapor contains tritium but the solution does not are developed and the solution does not are developed and verified by laboratory experiments. Results show that under environmental conditions, where the relative humidity is greater than 8%, HTO is lost preferentially over H2O to the atmosphere because atmospheric moisture is virtually free of HTO. Results from a three-year study of the changes in tritium content of a large nonseeping outdoor basin are used to extend the laboratory studies to field situations. Data from this field study were used to calculate tritium loss from open basins. These calculations show that 90% of the tritium contained in an aqueous stream flowing at 15,000 liters per day will be lost to the atmosphere from a shallow basin with a surface area of 6000 square m. (Woodard-

W71-06456

ATMOSPHERIC TECHNETIUM-99.

East Texas State Univ., Commerce. Dept. of Chemistry.

For primary bibliographic entry see Field 05A. W71-06457

ALKALINE SCALE ABATEMENT BY CARBON DIOXIDE INJECTION,
California Univ., Los Angeles. School of Engineering and Applied Science.

For primary bibliographic entry see Field 03A. W71-06458

Field 02-WATER CYCLE

Group 2K—Chemical Processes

American Chemical Society, Washington, D.C. For primary bibliographic entry see Field 02D.

GEOCHEMICAL AND GEOLOGICAL RECONNAISSANCE IN THE SEVENTYMILE RIVER AREA, ALASKA,

Geological Survey, Washington, D.C. For primary bibliographic entry see Field 02J. W71-06466

THEORETICAL MODEL FOR MANGANESE DISTRIBUTION IN CALCAREOUS SEDIMENT

Institut de Physique du Globe, Paris (France). For primary bibliographic entry see Field 02J. W71-06468

FORMATION OF ANTARCTIC BOTTOM WATER IN THE WEDDELL SEA,
Coast Guard, Washington, D.C. Oceanographic

Unit

For primary bibliographic entry see Field 02C.

SUMMARY OF DATA ON CHEMICAL QUALITY OF STREAMS OF NORTH CAROLINA, 1943-1967, Geological Survey, Washington, D.C.

Hugh B. Wilder, and Larry J. Slack.

Available from SOD, Washington, DC 20402 -\$1.75. Geological Survey Water-Supply Paper 1895-B, 1971. 236 p, 2 plate, 6 tab.

Descriptors: *Water quality, *Chemical analysis, *Surface waters, *North Carolina, Streams, Reviews, Water chemistry, Sampling, Data collections, Water analysis. Identifiers: *Water analyses compilation.

This report summarizes water-quality data collected by the U.S. Geological Survey in cooperation with the State of North Carolina during the period 1943-67. Maximum, minimum, and average values are shown for chemical analyses of mineral constituents dissolved in water from 177 locations at which samples were collected daily or monthly for at least 1 consecutive year. Maximum and minimum values are given for 460 'miscellaneous and occasional stations' at which two or more samples were collected. Also tabulated are analyses of samples from 580 sites at which only one sample for each site was collected. A total of about 19,000 analyses were used in determining statistical values included in the report. Water in streams of North Carolina is generally of good mineral quality and is acceptable with a minimum amount of treatment for most uses. (Woodard-USGS) W71-06489

INTERSTITIAL WATER STUDIES ON SMALL CORE SAMPLES, LEG 4,

Woods Hole Oceanographic Institution, Mass.; Geological Survey, Woods Hole, Mass.; and California State Coll., Long Beach. F. L. Sayles, F. T. Manheim, and K. M. Chan.

In: Initial Report of the Deep Sea Drilling Project, Vol 4, National Science Foundation, p 401-414, September 1970; Washington, DC, US Govern-ment Printing Office. 14 p, 4 tab, 14 ref.

Descriptors: *Diagenesis, *Water chemistry, *Sediments, *Cores, *Connate water, Sampling, Sedimentation, Data collections, Laboratory techniques, On-site tests, Salinity. Identifiers: Interstitial water.

Reorganization and recodification of shipboard procedures used in the Deep Sea Drilling Project for collecting interstitial waters result in improved and more regular collection and analysis of pore fluids. Comparative studies of waters squeezed and analyzed on shipboard and analyzed in the shore laboratory show generally good agreement. Influences of pressure and temperature during squeezing on composition of effluents were studied in clayey sample cores. Pressure was not found to be significant, whereas the temperature effects are significant, but are less than variations attributable to diagenetic reactions in the sediments. Conservative constituents, such as, chloride, sodium and bromide, remain relatively constant (within about 1.5%) with changing depth in the holes; but, large depletions with respect to normal sea water occur in calcium, magnesium, potassium, and sulfate in most of the cores. On the other hand, large en-richments of calcium and lithium occurred in some holes. (Knapp-USGS) W71-06497

DETERMINATION OF CARBONATE SATURA-

DETERMINATION OF CARBONATE SATURATION OF SEAWATER WITH A CARBONATE SATUROMETER,
California Univ., Los Angeles, Dept. of Geology; and California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics. For primary bibliographic entry see Field 07B. W71-06513

RADIOCHEMICAL ANALYSES OF WATER FROM WELLS, SPRINGS, AND STREAMS IN CENTRAL NEVADA,

Geological Survey, Denver, Colo. For primary bibliographic entry see Field 05B. W71-06669

RECONNAISSANCE OF SELECTED MINOR ELEMENTS IN SURFACE WATERS OF THE UNITED STATES, OCTOBER 1970, Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 07C. W71-06670

A UNIQUE RESULT OF MOSSBAUER SPEC-

TROSCOPY Technical Publishing Co., Barrington, Ill. Thompson Div.

F. W. Karasek

Research/Development, Vol 22, No 3, p 18-20, 22, March 1971, 4 p, 6 fig, 1 photo, 4 ref.

Descriptors: *Water pollution control, *Synthesis, *Instrumentation, *Spectroscopy, Chemical degradation, Fertilizer, Nutrients, Water quality, Wastes, Pollutants, Water chemistry, Herbicides. Identifiers: *Water degradable *Polymers, *Mossbauer spectroscopy.

Over 100 important commercial compounds have been polymerized with metals such as iron, copper and calcium to form water-degradable products. This report describes the functions of Mossbauer spectroscopy concerning the chemical bonding and structures involved. The value of these polymers for increasing the effectiveness of agricultural chemicals and reducing environmental pollution appears considerable. Initial emphasis has been placed on herbicidal uses. Pollution of water supplies commonly accompanies the application of herbicides in useful concentrations. Rain or irrigation water washes away much of the herbicide; hence overapplication is required for effective control, with several applications a year needed. A 2,4-D-iron polymer with a single application of 1 pound/acre has effectively controlled weeds on grazing lands in Kansas for over one year. Other tests show effectiveness in aquatic herbicidal use. (Woodard-USGS) W71-06672

THE EFFECT OF METEORIC WATER, MELT WATER AND BRINE ON THE COMPOSITION OF POLAR SEA WATER AND OF THE DEEP WATERS OF THE OCEAN,

Woods Hole Oceanographic Inst., Woods Hole, Mass; and Geological Survey, Washington, D.C. Alfred C. Redfield, and Irving Friedman.

Deep-Sea Research, Supplement to Vol 16, p 197-214, Pergamon Press, 1969. 18 p, 11 fig, 3 tab, 17

Descriptors: *Salinity, *Sea water, *Deuterium, *Melt water, *Arctic Ocean, Glaciers, Arctic, Water properties, Mixing, Brines, Rain water. Identifiers: *Baffin Bay.

The fresh water derived from melting sea ice may be distinguished from that derived from meteoric waters by its deuterium content. The apparent diluent of the Arctic Ocean waters has a deuterium content of about - 25% relative to Standard Mean Ocean Water, corresponding to the average composition of meteoric water, snow and glacial ice in the polar regions. The melt water from sea ice has very nearly the same deuterium content as the sea water from which it is frozen. In summer the subsurface layers of sea water in regions where ice is formed and melted seasonally differ very little in deuterium content although the salinity is reduced substantially by melt water. In confined straits and fiords the apparent diluent is derived about 3/4 from glacial ice and 1/4 from melting sea ice. It is estimated from deuterium-salinity relations that brine liberated in the freezing of sea ice increases the salinity of the subsurface water of Baffin Bay at 100 m by 0.36 parts per thousand and that of the water near the bottom of Kane Basin by 0.6 parts per thousand. The freezing of 2 meters of sea ice would be sufficient to liberate the quantity of salt required to produce these changes in salinity. Comparison of the deuterium and salinity concentrations in the deep water masses of the ocean with those of their presumed sources indicates that salt liberated as brine in the freezing of sea ice may increase the salinity by 0.02 to 0.16 parts per thousand over that which the deep water would have were it modified solely by dilution with polar meteoric water. The consequence of this effect in seeking the source of deep water is discussed. (K-napp-USGS) W71-06688

CASE-HARDENING OF CARBONATE ALLUVI-UM AND COLLUVIUM, SPRING MOUNTAINS, NEVADA,

Pennsylvania State Univ., University Park. Dept. of Geology and Geophysics For primary bibliographic entry see Field 02J. W71-06996

CHEMISTRY OF WATER, ICE, AND SNOW IN THE SCHIRMACHER PONDS, Arkticheskii i Antarkticheskii Na ledovatelskii Institut, Leningrad (USSR). Nauchno-Iss-

For primary bibliographic entry see Field 02H. W71-07019

METHODS FOR COLLECTION AND ANALY-SIS OF WATER SAMPLES FOR DISSOLVED MINERALS AND GASES, Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 01A. W71-07032

SEASONAL VARIATIONS, SULPHUR MOUN-TAIN HOT SPRINGS, BANFF, ALBERTA, Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch. For primary bibliographic entry see Field 02F. W71-07036

DETERMINATION OF SOME CHEMICAL AND PHYSICAL RELATIONSHIPS FROM RECORD-ING METERS IN LAKES,
Ontario Water Resources Commission, Toronto.

For primary bibliographic entry see Field 05A. W71-07045

Estuaries—Group 2L

A COLORIMETRIC METHOD FOR AMMONIA IN NATURAL WATERS,
Council for Scientific and Industrial Research, Pre-

toria (South Africa). National Inst. for Water

For primary bibliographic entry see Field 05A. W71-07046

2L. Estuaries

DIELDRIN AND ENDRIN CONCENTRATIONS

IN A LOUISIANA ESTUARY,
Ogden Coll. of Science and Technology, Bowling Green, Ky, and Oklahoma Univ., Norman. Dept. of Civil Engineering and Environmental Science; and Franklin Inst., Boston, Mass; and Riverside Research Labs., La Chasse, La.

For primary bibliographic entry see Field 05B.

W71-06460

MORPHOLOGY AND QUATERNARY HISTORY OF THE CONTINENTAL SHELF OF THE GULF COAST OF THE UNITED STATES, Office of Naval Research, Boston, Mass.; and

Woods Hole Oceanographic Institution, Mass. For primary bibliographic entry see Field 02J. W71-06493

THE EFFECTS OF THERMAL LOADING AND WATER QUALITY ON ESTUARINE PRIMARY PRODUCTION,
Maryland Univ., Solomons. Natural Resources Inst.

For primary bibliographic entry see Field 05C. W71-06595

WATER QUALITY AT PATUXENT RIVER BRIDGE, MARYLAND - JANUARY 1968 THROUGH NOVEMBER 1969,

Geological Survey, Arlington, Va. For primary bibliographic entry see Field 05A. W71-06664

SURFACE SALINITY ALONG THE EAST COAST OF THE UNITED STATES, Woods Hole Oceanographic Institution, Mass.

Joseph Chase.

Deep-Sea Research, Supplement to Vol 16, p 25-29, Pergamon Press, 1969. 5 p, 2 fig, 8 ref. Fish and Wildlife Service Contract No 14-17-0007-918.

Descriptors: *Salinity, *Sea water, *Atlantic Ocean, *Streamflow, *Coasts, United States, Mixing, Seasonal, Runoff, Rainfall, Water chemistry, Sampling, Data collections. Identifiers: U. S. East Coast.

The annual cycle of surface salinity at twelve locations off the east coast of the United States is discussed and related to the discharge and the proximity of rivers. The comparatively large ranges observed at the season of lowest salinity result largely from year to year variation in the time of the minimum and in the strength of the maximum river discharge. Generally the range is smaller in the early months of the year when the watersheds are frozen than in the late months before freezing is complete. (Knapp-USGS) W71-06687

RADIOACTIVE CESIUM IN ESTUARIES,

Naval Ordnance Lab., Silver Spring, Md. Nuclear Physics Div.

For primary bibliographic entry see Field 05B.

ECONOMIC ASPECTS OF OCEAN ACTIVI-TIES, VOLUME II. ECONOMIC FACTORS IN THE DEVELOPMENT OF A COASTAL ZONE, Massachusetts Inst. of Tech., Cambridge.

For primary bibliographic entry see Field 06B. W71-06776

BETWEEN TOMALES BAY AND ADJACENT SHELF WATERS,
Pacific Marine Station, Dillon Beach, Calif.
Stanley J. Marcus, and Roy S. Houston. Available from NTIS as AD-714 233, \$3.00 in paper copy, \$0.95 in microfiche. Pacific Marine Station Special Scientific Report No 7, July 1970. 45 p, tables.

LONG TERM CHANGES IN MARINE ECOSYSTEM: ECOLOGICAL RELATIONSHIPS

Descriptors: *Plankton, *Ecology, Ocean circulation, *Ocean currents, Temperature, Salinity, *Sea water, Hydrography, Continental shelf, Pacific ocean, Oceanography. Identifiers: *Marine biology, Marine meteorology, California, Tomales Bay, Upwelling, Black Swan waters! Secretary 1988.

Progress during the past year was primarily in the development of an offshore measurement capability and the initial stage of data collection in the region adjacent to Tomales Bay. Preliminary analysis indicates that several cycles of coastal upwelling having a period of five to six weeks, were observed by sequential measurements during the fall and winter months of 1969-1970. A low-cost operational capability has been achieved for the study of detailed density structure of shelf waters. Results detailed density structure of such waters, recomment only provide some understanding of the processes affecting Tomales Bay, but indicate a possible relationship of the density structure to be movements of commercially important fish in the

W71-06799

A NUMERICAL INVESTIGATION OF TIDAL CURRENT CIRCULATION IN THE GULF OF MAINE.

Naval Postgraduate School, Monterey, Calif. Arthur Paul Drenna.

Available from NTIS as AD-714 612, \$3.00 in paper copy, \$0.95 in microfiche. Thesis, MS in Oceanography, Naval Post Graduate School, Oct 1970. 69 p.

Descriptors: *Tides, *Mathematical models, *Ocean currents, *Wind tides, Waves. Identifiers: *Main Gulf, Fidal height.

The hydrodynamical-numerical model of Walter Hansen is used to compute tidal heights and tidal currents in the Gulf of Maine. The model uses two adjacent open boundaries at which the tides are prescribed at each time step, using four tidal constituents. The grid size is six nautical miles and the time step is thirty-one seconds. Seven data runs are reported; one uses the tides and no wind and the remaining six use uniform wind fields in consort with the tides. A modified method of handling the topographic data is used. The pertinent results of the study are: (1) the use of Hansen's Model with adjacent open boundaries produces broad subjective agreement with observed data, (2) the modified method of handling topographic input data is workable, (3) wind direction and velocity produce slight variations in tidal height, (4) wind direction and velocity modify the direction of the tidal currents considerably and produce some sig-nificant increases in tidal current speed, and (5) the modifying influences of wind fields on tidal heights, tidal current velocities, and tidal current directions are more noticeable in shallow water areas than in regions of deep water.
W71-06801

STRUCTURAL CHARAC-SHALLOW TERISTICS OF FLORIDA ATLANTIC SHELF AS REVEALED BY SEISMIC RELFLECTION PROFILES.

Army Coastal Engineering Research Center,

Army Coastal Engineering Research Center, Washington, D.C. Edward P. Meisburger, and David B. Duane. Available from NTIS as AD-702 003, \$3.00 in paper copy, \$0.95 in microfiche. Transactions, Gulf Coast Association of Geological societies, Vol 19, p 207-215, 1969.

Descriptors: *Continental shelf, *Seismic waves, *Sands, *Erosion, Florida.
Identifiers: Seismic reflection profiles, Sand

resources.

A sand resources survey off eastern Florida in 1965-66 by CERC resulted in the collection of 2,600 miles of seismic reflection profiles. With a penetration depth range of 0 to -500 feet MLW the profiles extend from nearshore (approximately 15-foot depth) to 15 miles offshore. The records show several prominent acoustic reflecting horizons at shallow depth which can be traced over large areas of the nearshore shelf. These areally extensive reflectors indicate some shallow structural features beneath the shelf surface; tentative stratigraphic correlations have been made in some cases with logged wells onshore. In CERC reflection records, the dominant structural feature is an almost universal eastward dip of strata. Subbottom acoustic horizons on the records are judged to represent a stratigraphic range from Eocene to Recent. Erosional surfaces and shallow water bedform features in the uppermost section are interpreted as resulting from Pleistocene sea level fluctuations. W71-06928

RECENT SEDIMENTS OF BOLINAS BAY, CALIFORNIA. PART C. INTERPRETATION AND SUMMARY OF RESULTS, California Univ., Berkeley. Hydraulic Engineering

P. Wilde, C. Isselhardt, L. Osuch, and T. Yancey. Available from NTIS as AD-704 694, \$3.00 in paper copy, \$0.95 in microfiche. Technical Report HEL-2-23, December 1969. 86 p.

Descriptors: *Sedimentation, *Continental shelf. *Petrography. Identifiers: *Heavy minerals, Bolinas Bay (Calif).

Samples of marine sediments and shore rocks from Bolinas Bay, California, were analyzed for grain size and heavy mineral content. This work, part of a study of sediment transport off Central California, indicates: (1) heavy mineral assemblage is predominantly green hornblende with secondary amounts of hypersthene and augite. Nearshore glaucophane and jadeite occur in locally high concentrations. (2) Distribution pattern of the heavy minerals shows a tongue of high concentrations of minerals that have a granitic source extending northwest from the San Francisco Bay, flanked on the north and northeast by increasing landward concentrations of Franciscan metamorphic minerals. (3) The major source of heavy minerals is the San Francisco Bay. Secondary contributions come from Bolinas Lagoon and the adjacent cliffs. (4) Circulation in the bay is primarily counterclockwise; produced by a combination of wave refraction around Duxbury Reef and the tidal coast eddy current. Tidal influence, however, of Bolinas Lagoon is restricted to about 1 mile from the lagoon mouth. Circulation patterns in the bay greatly influence sediment distribution. (5) Annual sediment flux in Bolinas Bay is about 300,000 cubic yards; bottom sediments are apparently in quasiequilibrium. W71-06929

MOLECULAR PHYSICS OF THE SEA, PART

Naval Research Lab., Washington, D.C. For primary bibliographic entry see Field 05B. w7i-06938

TRACING SAND MOVEMENT IN THE LITTORAL ZONE: PROGRESS IN THE RADIOISOTOPIC SAND TRACER (RIST) STU-DY, JULY 1968-FEBRUARY 1969,

Army Coastal Engineering Research Center, Washington, D.C.

David B. Duane.

David B. Duane. Available from NTIS as AD-713 001, \$3.00 in paper copy, \$0.95 in microfiche. Corps of En-gineers Miscellaneous Paper No 4-70, August 1970. 52 p, 25 fig, 1 tab, 25 ref.

Group 2L—Estuaries

Identifiers: *Seacoast (Sand), *Sand (Tracer studies), Transport properties, Labeled substances, Radioactive isotopes, Xenon, Radiation measurement systems, Cesium compounds, Sedimentation, Gold. Tides, Beaches, California, (Radioisotopic Sand Tracer Study), *Radioisotopic sand tracer study, Littoral zone, *Sediment

Tagging procedures, instrumentation, field surveys and data handling techniques have been developed by the radioisotopic sand tracing study for the col-lection and analysis of over 12,000 bits of information per hour over a survey track of about 18,000 feet. Data obtained can be considered as nearly synoptic observations of sediment transport in a single environmental zone or in adjacent beach, surf and offshore zones. Experiments at Surf, Point Conception, Point Mugu, and Oceanside, California, used sand tagged with isotopes of xenon or gold. Data from studies in beach areas unmodified by littoral barriers indicate that the alongshore velocity of sediment transport differs from zone to zone. Transport seaward of peaking, breaking waves is less than transport on the beach face which is less than transport in the plunge and surf zone. Zone dimensions change with waves and tides. Tracing surveys confined to the foreshore of offshore zones produce data only partly indicative of transport in the zone of immediate concern to coastal engineers. Studies conducted at the site of shore structures indicate the RIST system can provide data useful in understanding the effect of such structures on sediment transport. W71-06941

SOURCE AND MIXING OF INSOLUBLE CLAY MINERALS IN A SHALLOW WATER CARBONATE ENVIRONMENT - FLORIDA BAY, University of South Florida, Tampa. Dept. of

Geology.
J. P. Manker, and George M. Griffin.
Journal of Sedimentary Petrology, Vol 41, No 1, p
302-306, March 1971. 5 p, 3 fig, 12 ref.

Descriptors: *Bottom sediments, *Provenance, *Sediment transport, *Suspended load, *Clay minerals, Deposition (Sediments), Mud, Marl, Currents (Water), Tides, Tidal effects. Identifiers: *Florida Bay.

Chlorite and smectite dominate the clay-size insoluble residue of Recent carbonate sediments of Florida Bay. Illite and kaolinite also occur in very small quantities. Chlorite is derived from the Atlantic Coast and eastern Everglades provinces and is introduced by streams and by tidal channels through the northern Florida Keys. Smectite is derived from the Gulf of Mexico province to the west. In the northern part of Florida Bay, water flow is greatly impeded by a complex bank and basin system, and the clay mineral suites remain relatively segregated near their respective sources. However, in the southern part of the bay, banks are less frequent, water flow is less impeded, and the clay mineral suites mix gradually across the area. (Knapp-USGS) W71-06997

RELATIONSHIP BETWEEN GRAIN SIZE PARAMETER DISTRIBUTION AND CURRENT PATTERNS IN THE GIRONDE ESTUARY (FRANCE),

Inst. of Gelogie du Bassin d'Aquitaine, Facultes des Sciences, Bordeaux, France.

George P. Allen.
Journal of Sedimentary Petrology, Vol 41, No 1, p 74-88, March 1971, 15 p, 16 fig, 43 ref.

Descriptors: *Sediment transport, *Bed load, *Particle size, *Waves (Water), *Estuaries, Bottom sediments, Currents (Water), Sedimentary structures, Sedimentation, Sedimentary petrology, Statistical methods, Distribution patterns. Identifiers: Gironde Estuary (France).

The bottom sediments in the marine portion of the Gironde estuary were sampled and studied in rela-

tionship to the local wave and tidal current patterns. A semi-empirical analysis was conducted to delimit the areas of wave refraction and the bottom orbital velocity variations. Compilation of the curorbital velocity variations. Compilation of the cur-rent and wave energy data from on-site measure-ments show that distinct energy zones exist, each characterized by different current strength and type. These zones are controlled by the morpholog-ical features of the estuary, the tidal and wave energy zones being mutually exclusive. Most of the tidal gy zones being mutually exclusive. Most of the tidal current discharge occurs in the deeper channels, whereas the shoal areas are the site of important wave energy. Most of the sediments are sands (phi means between 2.0 and 0.5). A large gravel deposit, however, was observed at the entrance of the estuary. The textural parameter distribution patterns of the sands coincide with and reflect the different energy zones. The gravel deposit is in-ferred to be a fossil alluvial terrace because it does not seem to be in accord with the present-day current patterns. The inferred transportational processes reflect the established energy zones. A CM curve analysis indicates a graded suspension transport mode for zones where wave energy predominates, and bed-load transport for areas in fluenced by tidal currents. This effect seems to be corroborated by consideration of the orbital bottom wave velocity as a function of depth. The depth limit for the transporational processes due to wave activity seems to be about 15 meters. Beyond this depth, the sediment is transported mainly by the tidal currents. (Knapp-USGS) W71-07001

ON THE MANAGEMENT OF GROUNDWATER IN COASTAL AQUIFERS, North Carolina State Univ., Raleigh. Dept. of Civil

Engineering. For primary bibliographic entry see Field 04B. W71-07005

THE INFLUENCE OF DECOMPOSING SAL-MON ON WATER CHEMISTRY,
Alaska Univ., College. Inst. of Water Resources. For primary bibliographic entry see Field 05B. W71-07057

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

ALKALINE SCALE ABATEMENT BY CARBON

ALKALINE SCALE ADATEMENT BY CARBON DIOXIDE INJECTION, California Univ., Los Angeles. School of Engineer-ing and Applied Science. Ronald D. Ellis, Julius Glater, and Joseph W.

McCutchan.

Environmental Science and Technology, Vol 5, No 4, p 350-356, April 1971. 7 p, 8 fig, 3 tab, 23 ref.

Descriptors: *Scaling, *Desalination, *Abatement, *Carbon dioxide, Injection, Alkaline water, Magnesium hydroxide, Calcium carbonate, H transfer, Temperature, Methodology, Sea water.

Distillation of untreated seawater results in precipitation of alkaline scaling compounds (calcium carbonate and magnesium hydroxide) on heat transfer surfaces. Scale deposition was successfully eleminated by continuous injection of carbon dioxide. Threshold levels for scale control increase with distilling temperature and range from 37 ppm at 255 deg F to 64 ppm at 284 deg F. Profiles of carbon dioxide concentration, pH, and scale composi-tion were studied over a wide temperature range. Special techniques were developed for injection of carbon dioxide and monitoring the concentration in a pressured system. Methods were also determined for collection and analysis of scale deposits. Carbon dioxide injection offers advantages over acid injection or polyphosphate-based additives which are currently used for controlling alkaline scale. (Woodard-USGS)

W71-06458

CONCERNING THE ECONOMIC VALUE OF EXPERIMENTATION IN THE DESIGN OF DESALTING PLANTS.

Department of Commerce, Washington, D.C. Myron Tribus, and Jacques P. Pezier.
Desalination, Vol 8, No 3, p 311-349, December 1970. 39 p, 8 fig, 6 tab, 13 ref, 2 append.

*Desalination plants, Descriptors: *Economics, *Decision making, *Optimization, *Statistical methods, Costs, Numerical analysis. Identifiers: *Utility function, Experimentation.

This paper was concerned with the analysis of the economic worth of design data gathering, that is, the determination of the various coefficients and design parameters which cannot be computed from design parameters which cannot be computed from prior experience or from first principles, for design of desalting plants. In the analysis techniques known under the general title 'Decision Analysis' were used and the Kelvin objective function was shown to represent the balance between capital costs and operating costs for most desalting plants.
For the purposes of this paper all costs and income were reduced to present values. Since in practice the designer doesn't know the precise values of the variables the concern here was with the expected value of information computed by the designer before the experiment is undertaken. In the field of Decision Analysis risk preference or aversion is treated by describing a utility function for the decision maker. Two cases of interest, Case IA: the utility of money equal to its face value and the plant must be built, and Case 2A: the plant is to be built anyway and the utility of money is non-linear were described in detail including equations, examples, experiments and computer programs. A numerical example which considered a plant for which prior expected values were known was illustrated. It was concluded that it is extremely important to determine the exact circumstances under which a system is to be optimized in order to infer the value of information about design of an experiment. (Kriss-Cornell) W71-06590

3B. Water Yield Improvement

WILDLIFE VERSUS IRRIGATION,

Science Service, Washington, D.C. Richard H. Gilluly. Science News, Vol 99, No 11, p 184-185, March 13, 1971. 2 p, 2 fig.

Descriptors: *Vegetation effects, *Defoliants, *Irrigation, *Wildlife, *Arizona, Reviews, Evaluation, Streams, Banks, Phreatophytes, Water yield, Evapotranspiration.
Identifiers: *Phreatophyte removal controversy.

In Arizona, Federal agencies are studying the removal of phreatophytes-deep-rooted vegetation-from the banks of many rivers in the state. The main purpose of the removal is to conserve water in that arid state. The phreatophytes, stress the advocates of removal, absorb water from the water table and release it to the air through evapotranspiration. Removal of the plants from waterways, they say, will make more water available for downstream irrigation. Bitterly opposing the phreatophyte removal projects, are conservationists and wildlife proponents who say that the riverbank vegetation is the only major wildlife habitat in the arid state. Remove it, they say, and the adverse effects on wildlife will be devastating and sometimes irreversible. Other arguments raging around the phreatophyte removal proposals are discussed. (Woodard-USGS)
W71-06465

PHREATOPHYTES - A BIBLIOGRAPHY.

Water Resources Scientific Information Center, Washington, D.C.

Conservation in Industry—Group 3E

Available from NTIS as PB-198 305, \$3.00 in paper copy, \$0.95 in microfiche. Report WRSIC 71-200, April 1971, unpaged.

*Phreatophytes, *Brush control. *Water utilization, *Water yield improvement, Water loss, Weeds, Evaporation, Evapotranspira-tion, *Bibliographies, Abstracts, Chaparral, Arid lands, Desert plants, Cottonwoods, Mesquite, Sagebrush, Tamarisk, Shrubs. Identifiers: Shrub control.

This compilation of 122 abstracts is the first in a series of planned bibliographies in water resources to be produced wholly from the information base comprising only SELECTED WATER RESOURCES ABSTRACTS (SWRA). At the time of search for this bibliography, the information base comprised 25,104 abstracts covering SWRA through March 15, 1971 (Volume 4, Number 6). A keyword-in-context (KWIC) index is provided to guide the user to relevant abstracts. W71-06596

WATER SUPPLY AND DEMAND,

Cornell Univ., Ithaca, N.Y.
For primary bibliographic entry see Field 06D. W71-06598

WATER WELL HANDBOOK,

Missouri Water Well and Pump Contractors Association, Rolla, Mo. For primary bibliographic entry see Field 08A.

A STUDY TO EVALUATE POTENTIAL SOLUTIONS TO THE PROBLEM OF INSURING AN ADEQUATE WATER SUPPLY FOR NEW CASTLE COUNTY, DELAWARE.
University City Science Center, Philadelphia,

Pennsylvania.

Available from National Technical Information Available from National Technical Information Service as PB-198 433, \$3.00 in paper copy, \$0.95 in microfiche. Philadelphia, University City Science Institute, March 22, 1971. 132 p, 12 fig, 19 tab, 43 ref. USCI-ES-3.

Descriptors: *Water management (Applied), *Water resources development, Cost-benefit analysis, Technical feasibility, Water supply, Water demand, Reservoirs, Dams, Inter-basin transfer, Artificial recharge, Ecology, Recreation.

Identifiers: *New Castle County, Delaware,

Schuylkill River, Susquehanna River.

This study concludes that current water demand exceeds current safe yield in New Castle County, Delaware, that the deficit may increase by 2 to 3 million gallons per day in the near future, and that, from the economic and engineering viewpoints, the proposed White Clay Creek Dam and Reservoir has the greatest prospect of any proposed project for increasing water supply. Previous engineering, economic, and feasibility studies of the water resources and demand projections in the county are reviewed. Aspects discussed include: projected water demand and county needs, an economic analysis of the White Clay Creek Dam and Reservoir proposal, other currently feasible alternatives, groundwater development, a study of the ecological and aesthetic aspects of the reservoir site, and a projection of economic conditions and financing alternatives. Other alternatives discussed include an interbasin transfer from the Schuylkill and Susquehanna Rivers to the White Clay Creek, proposed by the Mason-Dixon Task Force, and a large-scale artificial groundwater recharge project. (Dorr-USSC)
W71-06933

TAKING REPRESENTATIVE FORMATION

U.O.P., St. Paul, Minn. Johnson Div. For primary bibliographic entry see Field 08B. W71-06945

INTERPRETATION OF ELECTRIC LOGS IN FRESH WATER WELLS SOLIDATED FORMATIONS, IN

Schlumberger Well Surveying Corp., Houston,

Society of Professional Well Log Analysts Symposium, Houston, Texas, 1966. 25 p, 4 tab, 15 fig, 12

Descriptors: *Borehole geophysics, *Water wells, *Water quality, Resistivity, Bicarbonates, Drilling fluids, Chlorides, Specific conductance, Size, Particle size, Salinity tolerance.

Identifiers: *Specific potential, Salinity-resistivity chart (Fresh water), Divalent cations, Formation resistivity, Total dissolved solids, Grain size, Surface conductance, Size analysis, Sorting evaluation.

Evaluation of wells drilled for fresh water present special problems in log analysis. In such analyses the problem is not to distinguish between two types of fluid, as in the evaluation of oil prospects, but to determine the quality and quantity of water that may be obtained from various strata. In oil field interpretation Rw determination through SP analysis is usually satisfactory. There, the interrelations between concentration, activity, and resistivity are well established because NaC1 interrelationship does not apply. The SP is used for determination of fresh water quality, but firm empirical data for the locale are required. Measurements of resistivity provide the means for determining relative productivities of fresh water sands. Unconsolidated sands generally exhibit uniformly high porosities; how-ever, a surface conductance effect in fresh water sands causes the formation resistivity factor to vary with both Rw and grain size. Because permeability is related to grain size, resistivity values indicate relative productivity. (Campbell-NWWA) W71-06947

WELL POINT SYSTEMS.

U.O.P., St. Paul, Minn. Johnson Div. For primary bibliographic entry see Field 08B. W71-06948

TESTING WATER WELLS FOR DRAWDOWN AND YIELD.

U.O.P., St. Paul, Minn. Johnson Div For primary bibliographic entry see Field 08B.

SOURCE WATER WELL DESIGN AND EFFI-

CIENCY, U.O.P., St. Paul, Minn. Johnson Div. For primary bibliographic entry see Field 08B. W71-06951

3C. Use of Water of Impaired Quality

THE EFFECT OF SELECTED HYDROLOGIC VARIABLES ON STREAM SALINITY, Agricultural Research Service, Chickasha, Okla. For primary bibliographic entry see Field 06A. W71-06588

DESALTING SALINE WATER FOR IRRIGA-TION--A CASE STUDY--COACHELLA AREA, Bureau of Reclamation, Boulder City, Nev.

Paper 6th American Water Resources Conferences Conference, Las Vegas, Nevada, October, 1970. 19 p, 8 fig, 4 tab, 15 ref.

Descriptors: *Demineralization, *Saline water, *Agriculture, Salinity, *Irrigation water, Membrane processes, Desalination processes, Water costs, Distillation, Benefit-cost retios, Investment, Crop production, Bibliographies, Brine disposal, Consumptive use (Water), Multistage flash distillation, Operating costs, Water sources, Costs, *Desalination.

Identifiers: *Saline agriculture, Coachella Valley

A study was performed to evaluate potential applications of desalted saline water for agriculture using 2 distillation and 2 membrane processes. The investigation determined costs and benefits asinvestigation determined costs and benefits associated with desalting saline water at concentrations of 1500, 900, 400, 200 and 50 ppm. Benefits from desalting are generated by shifts to more profitable crops, reduced costs for drainage, and reduced fertilizer and labor requirements with better quality water. Costs are based on project features used to describe above the contractions and the contractions and the contractions are set of the contractions and the contractions are set of the contractions and the contractions are set of the contractions are set of the contractions and the contraction are set of the contractions are set of the tures such as desalting plants, raw water diversion facilities, storage reservoirs, conveyance and dis-tribution systems, brine disposal, blending facili-ties, and gypsum addition systems. Hydrologic studies determined crop irrigation requirements, water demand schedules, desalted water storage requirements, brine disposal requirements, and size of facilities required. Reconnaissance design layouts were made for producing desalted water using a combination of 14 schemes. Benefit-cost ratios range from 0.4 to 1.0 for 1500 ppm irrigation water to 0.8 to 1.0 for 50 and 200 ppm water. Investment costs per acre are high, ranging from \$12,900 to \$20,900. Irrigation benefits are based on the increase in production from a desert condition with no water supply to the irrigation conditions studied. (USBR) W71-06833

3D. Conservation in Domestic and Municipal Use

HYDROLOGICAL AND ENVIRONMENTAL CONTROLS ON WATER MANAGEMENT IN AN ARID URBAN AREA,

Arizona Water Resources Research Center, Tuc-

For primary bibliographic entry see Field 04C. W71-06597

WATER AND RELATED LAND RESOURCES -STATE ADMINISTRATION, LEGISLATIVE PROCESS AND POLICIES IN MINNESOTA, 1970.

Minnesota Univ., Minneapolis. For primary bibliographic entry see Field 06E. W71-06599

3E. Conservation in Industry

WATER FOR INDUSTRIAL DEVELOPMENT IN AMITE, FRANKLIN, LINCOLN, PIKE, AND WILKINSON COUNTIES, MISSISSIPPI, Geological Survey, Jackson,

Resources Div.

Roy Newcome, Jr., and F. H. Thomson.

Mississippi Research and Development Center Report, 1970. 61 p, 20 fig, 12 tab, 20 ref, append.

Descriptors: *Water resources, *Industrial water, *Appraisals, *Planning, *Mississippi, Groundwater, Streamflow, Water quality, Hydrologic data, Geohydrologic units, Artesian wells, Water resources development, Water utilization, Perennial streams.

Identifiers: Amite County, Franklin County, Lincoln County, Pike County, Wilkinson County.

Details are given on availability, chemical quality, and physical characteristics of groundwater and surface water of this five-county area in southwest Mississippi, based on an investigation begun in July 1967. Designed as a planning guide for development and management of water supplies, the report contains 20 illustrations, 12 data tables, and the interpretive text. Five geohydrologic sections in dif-ferent parts of the area show depth and thickness of aquifers, clayey beds, and the base of fresh water; maps and tables give the DO and low-flow velocities for major streams; and data tables given chemical analyses, streamflow records, well records, and

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3E—Conservation in Industry

data on potential supply at selected places. Streams and aquifers have scarcely been tapped for water supplies and present pumpage from wells totals less than 10 mgd. The only significant water problem is excessive iron; most public and industrial water supplies are aerated for iron removal. Sixteen streams in the area can supply 5 mgd each without storage during drought periods; 8 could supply 10 mgd each and 3 streams could supply 100 mgd. storage during drought periods; a could supply 10 mgd each and 3 streams could supply 100 mgd each. With storage, the Homochitto River could provide 350 mgd and Bogue Chitto 250 mgd in a drought of 10-yr recurrence interval. The 1,300-to 3,000-ft section of Miocene sand and clay contains numerous artesian aquifers of various thicknesses and irregular extent. Only a few wells produce and irregular extent. Only a few wells produce more than 500 gpm, but a great many of the aquifers could support well yields of 2,000 gpm, or more. The groundwater is soft and low in mineralization (usually less than 200 mg per liter). Natural thermal conditions may preclude some uses of surface water for industrial needs. (Lang-USGS) W71-06510

3F. Conservation in Agriculture

A SIMULATION OF IRRIGATION SYSTEMS--THE EFFECT OF WATER SUPPLY AND OPERATING RULES ON PRODUCTION AND INCOME ON IRRIGATED FARMS,

Economic Research Service, Fort Collins, Colo. Natural Resource Economics Div. For primary bibliographic entry see Field 06A. W71-06581

A UNIQUE RESULT OF MOSSBAUER SPEC-

Technical Publishing Co., Barrington, Ill. Thompson Div.

For primary bibliographic entry see Field 02K. W71-06672

MECHANIZED SURFACE **IRRIGATION** SYSTEMS FOR ROLLING LANDS,

California Univ., Davis. Dept. of Water Science

and Engineering. William E. Hart, and John Borrelli.

California University Water Resources Center Contribution No 133, June 1970. 93 p, 43 fig, 6 tab, 7 ref, append. Water Resources Center Project UCAL-WRC-70-W-175.

Descriptors: *Irrigation design, *Automation, Irrigation ditches, Irrigation programs, Irrigation systems, Irrigation efficiency, California, Topography, Furrow irrigation, Application equipment, Water distribution (Applied). Identifiers: *Automatic irrigation equipment,

*Sierra Nevada (Calif.).

This report describes, in detail, a surface irrigation system which makes more efficient use of and labor in the rolling lands of the Sierra Nevada Foothills than do existing systems, and at only a slight increase in capital cost. Design details are included, with some management techniques for the system as applied to irrigated pastures. Much of the information is applicable to other crops. Fully-automatic or semi-automatic check structures allow the irrigator to make several sets at a single visit to a field. A system of outlets retains its settings and is unaffected by animals within the field, ground settlings, or factors other than the level of the water in the supply ditch. A system of corrugations (small furrows) runs downslope from the head or distribution ditches. These corrugations, if properly constructed and maintained, assure that any water properly distributed at the upper edge of the field (by the outlets) will be properly distributed at the lower edge of the field. Upon operation, with no increase in labor, the water application efficiency (usefully applied water divided by total applied water) was increased from about 35 percent to 80 percent. (Knapp-USGS) W71-07050

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

WILDLIFE VERSUS IRRIGATION, Science Service, Washington, D.C. For primary bibliographic entry see Field 03B.

FLOOD PLAIN INFORMATION, BRANCH PENNSAUKEN CREEK, BURLING-TON COUNTY, NEW JERSEY. Corps of Engineers, Philadelphia, Pa.

Corps of Engineers Flood Plain Report, December 1970. 49 p, 8 fig, 10 plate, 8 tab.

Descriptors: *Floods, *Flood damage, *Flood plains, *New Jersey, Regional flood, Flood forecasting, Flood control, Peak discharge, Rainfall-runoff relationships, Historic flood. Identifiers: *Burlington County (NJ), Standard project flood, Intermediate regional flood.

Flooding along the North Branch of Pennsauken Creek from its confluence with the South Branch upstream to the New Jersey Turnpike bridge and the Strawbridge Lake tributary from its confluence with North Branch upstream to the New Jersey Route 38 bridge is described to aid in solving local flood problems and in planning the best utilization of flood-prone lands. Maps, profiles, cross sections and other material relating the extent of past flooding to floods which might occur in the future are based on available records of rainfall, runoff, historical flood heights and other technical data. The greatest flood known to have occurred in the lower reaches of Pennsauken Creek is the August 1933 flood resulting from tidal flooding on Delaware River. This flood produced stages of 9.0 feet, mean sea level datum at the mouth of Pennsauken Creek and 11.0 feet at the confluence with the South Branch. (Woodard-USGS) W71-06517

FLOOD PLAIN INFORMATION, BIG COTTON INDIAN, LITTLE COTTON INDIAN, TAR AND PANTHER CREEKS - PART METROPOLITAN ATLANTA, GEORGIA. Corps of Engineers, Savannah, Ga.

Corps of Engineers Flood Plain Report, January 1971. 44 p, 21 fig, 58 plate, 13 tab.

Descriptors: *Floods, *Flood damage, *Flood plains, *Georgia, Regional flood, Flood forecasting, Flood control, Historic flood.

Identifiers: *Henry and Clayton Counties (Ga), Standard project flood, Intermediate regional

Flooding in Henry and Clayton Counties, Georgia, along Big Cotton Indian, Little Cotton Indian, Tar, and Panthers Creeks from the mouth of Big Indian Creek on South River to their headwaters is described to aid in solving local flood problems and in planning the best utilization of flood-prone lands. Maps, profiles, cross sections and other material relating the extent of past flooding to floods which might occur in the future are based on available records of rainfall, runoff, historical flood heights and other technical data. The storm of December 7-10, 1919 produced the flood of record. Moderate precipitation occurred December 6-8, but on December 8-9 there was 11.8 inches of rainfall recorded at the Atlanta station. Based on information of high water marks on nearby streams, this flood has a frequency of over 100 years. (Woodard-USGS) W71-06522

STOCHASTIC DYNAMIC PROGRAMMING FOR OPTIMUM RESERVOIR OPERATION Texas Univ., Austin, Center for Research in Water Resources

William S. Butcher.

Water Resources Bulletin, Vol 7, No 1, p 115-123, February 1971. 9 p, 3 fig, 12 ref.

Descriptors: *Dynamic programming, *Stochastic processes, *Optimization, Water resources development, *Multiple-purpose reservoirs, development, *Multiple-purpose reservoirs,
Operations, Monthly, Time, Streamflow, Equa-Identifiers: *Watasheamu Dam.

A study in which an optimal operating policy for a multipurpose reservoir was determined was presented, where the optimal operating policy was stated in terms of the state of the reservoir indicated by the storage volume and the river flow in the preceding month and used a stochastic dynamic programming approach. Watasheamu Dam, a dam proposed to be built by the Bureau of Reclamation near the Nevada-California state line was used for application of this method. Streamflows at the site were measured for 28 years and return functions and physical data for the dam were available. A time period of one month was chosen. The formulation of the dynamic programming recursive equation was shown. To carry out the calculations, it was necessary to first describe the probabilities of a stream having one flow value in one time period, and another in the next time period. The correlation between monthly stream flows was analyzed by a method in which a linear regression line was established between flows of successive months by a least squares fit to determine a linear relationship between two time periods. With this modified for-mulation and data for the Watasheamu Dam site, calculations were made by computer. Sample results of the optimum policy determination were given for one of the possible twelve months of the year. (Kriss-Cornell) W71-06582

HEC-3 RESERVOIR SYSTEM ANALYSIS. Corps of Engineers, Davis, California. Hydrologic Engineering Center.

Computer Program 723-X6-L2030, Hydrologic Engineering Center, Corps of Engineers, US Army, Davis, California, February 1971. 139 p.

Descriptors: *Computer programs, *Systems analysis, *Reservoirs, *Flow, *Optimization, *Multiple-purpose projects, Input-output analysis, Power-plants, Economics.

The computer program presented was written in Fortran IV and performed a multipurpose routing of a reservoir system by any number of periods of uniform varying length per year based on varying flow requirements at reservoirs, diversion and downstream control points and power peaking and energy requirements at reservoirs. It accepted any configuration of reservoirs, diversions, power plants and control points, and accepted system power demands that override individual power plant requirements, but did not provide for channel routings or percolation losses. It could assign economic values to all outputs and summarize and allocate these in various ways. It could automatically iterate to optimize yield at a specified location. All requirements were supplied from reservoirs so as to maintain a specified balance of storage in all reservoirs and was capable of performing short-interval flood studies. The program was prepared for use in the CDC 6600 computer and all project requirements could be entered in any sequence, but were performed in downstream sequence each period. Input and output data were summarized in the exhibits and operating instruc-tions were given. Proposed future development for the program was discussed. (Kriss-Cornell) W71-06586

WATER QUANTITY MANAGEMENT AND CONTROL-Field 04

Control of Water on the Surface—Group 4A

PHREATOPHYTES - A BIBLIOGRAPHY.

Water Resources Scientific Information Center, Washington, D.C.

For primary bibliographic entry see Field 03B. W71-06596

HANDBOOK OF STEEL DRAINAGE AND HIGHWAY CONSTRUCTION PRODUCTS: CHAPTER 11 - AIRPORT DRAINAGE. For primary bibliographic entry see Field 08A.

FINANCING CONSTRUCTION OF A MAJOR DRAINAGE IMPROVEMENT,

Peter M. Callihan. Public Works, Vol 100, No 6, p 105-106, June 1969.

Descriptors: *Storm runoff, *Construction costs, Drainage systems, California. Identifiers: Drainage improvements.

Rohnert Park, Sonoma County, and the Sonoma County Flood Control District have developed a new method of financing major drainage channels. One channel, which served as a major drainage facility to accommodate storm flows from the anticipated high density development area, could not be improved because of costs. A policy requiring land developers to improve all major drainage ways was adopted and the problem was solved. A large drainage area plan is discussed along with problems of financing its improvements. W71-06652

REMOTE 'EYES AND EARS' FOR FLOOD WARNINGS.

Corps of Engineers, Boston, Mass. New England

For primary bibliographic entry see Field 07A.

FISHERY MANAGEMENT PROGRAM, EX-PANDED PROJECT FOR AQUATIC PLANT CONTROL-FIELD TEST AREAS - FINAL RE-PORT.

Bureau of Sport Fisheries and Wildlife, Atlanta, Ga. Div. of Fishery Services.

For primary bibliographic entry see Field 05C. W71-06703

SOIL MOISTURE TYPES OF THE AMUR OBLAST (Russian: Tipy Uvlazhennosti Landshaftov Amurskoy Oblasti),

For primary bibliographic entry see Field 02G. W71-06710

NORTH RACCOON RIVER FLOOD PLAIN INFORMATION, SAC COUNTY, IOWA. Corps of Engineers, Rock Island, Ill.

Corps of Engineers Flood Plain Report, June 1970. 51 p, 38 fig, 11 plate, 9 tab.

Descriptors: *Floods, *Flood damage, *Iowa, Flood plains, Regional flood, Flood forecasting, Flood control, Historic flood.

Identifiers: Sac County (Iowa), Standard Project Flood, Intermediate Regional Flood.

The flood situation along the North Raccoon River flood plain, in Sac County, lowa, starting from the county bridge at mile 3.0 upstream to the county bridge at mile 11.97 is described to aid in solving local flood problems and in planning the best utilization of flood-prone lands. Maps, profiles, cross sections, and text material relating the extent of past flooding to floods which might occur in the future are based on available records of rainfall, runoff, historical flood heights and other technical data. Flood duration on the North Raccoon River is relatively long. During the flood of September 1, 1962, the water rose from an initial stage of 5 feet

to peak stage of 18.12 feet in less than 2 days and to peak stage of 18.12 feet in less than 2 days and remained above bankfull stage for 12 days. During the March 1960 flood, the river rose to peak stage of 16.73 feet in about 2 days and remained above bankfull stage for 8 days. (Woodard-USGS)

CEDAR RIVER FLOOD PLAIN INFORMATION, BLACK HAWK COUNTY, IOWA. Corps of Engineers, Rock Island, Ill.

Corps of Engineers Flood Plain Report, June 1970. 72 p, 44 fig, 27 plate, 9 tab.

Descriptors: *Floods, *Flood damage, *Iowa, Flood plains, Regional flood, Flood forecasting, Flood control, Historic flood.

Identifiers: *Black Hawk County (Iowa), Standard Project Flood, Intermediate Regional Flood.

Flooding in Black Hawk County, Iowa, along Cedar River and Elk Run Creek, including the cities of Evansdale, Waterloo, Cedar Falls, and Elk Run Heights is described to aid in solving local flood problems and in planning the best utilization of flood-prone lands. Maps, profiles, cross sections, and text material relating the extent of past flooding to floods which might occur in the future are based on available records of rainfall, runoff, historical flood heights and other technical data. The greatest known flood occurred in March 1961. Maximum recorded stage at the USGS gaging station was 21.86 feet (elevation 845.95 feet above mean sea level, datum of 1929). The maximum discharge during this flood was 76,700 cfs on March 29, 1961. Standard Project Flood determination indicates that floods could occur on the Cedar River between 6.1 and 12.1 feet higher than the March 1961 flood. (Woodard-USGS) W71-06722

CONTROL PROVISED MAJOR FLOOD

Walter J. Wood, and N. Christian Datwyler.
Public Works, Vol 101, No 6, p 67-68, Jun 1970.

Descriptors: *Drainage systems, *Flood control, *Storm drains, Overflow. Identifiers: *Connecting tunnel.

The Department of Housing and Urban Development recently granted funds to the Los Angeles County Flood Control District for the construction of a storm drainage system. Such a system will eliminate problems caused by accumulated storm-water sumps along the undulating terrain of the area. Such stormwater accumulations have caused drownings and mosquito proliferation, and they sometimes overflow and flood surrounding areas or infiltrate the sewer system creating a health hazard. The project consists of a tunnel connecting storm drains to the Pacific Ocean. The new drainage system will encourage redevelopment in the area by resolving the problems presently making the region an unattractive and often-dangerous place to

W71-06758

APPLIED FLOOD HYDROLOGY,

For primary bibliographic entry see Field 05G. W71-06773

FORT SMITH URBANIZING AREA: WATER, SEWER AND STORM DRAINAGE PLAN, VOLUME I, WATER.

Available from NTIS as PB-195 689, \$3.00 in paper copy, \$0.95 in microfiche. Report, Arkhoma Regional Planning Commission, Fort Smith, Ark, June 1970. 134 p. HUD Project Ark P-105.

Descriptors: *City planning, *Urbanization, *Water supply, *Land use, Watersheds, Economic feasibility, Arkansas.

Identifiers: Population growth, Economic analysis, *Fort Smith, Arkansas.

The water, sewer and drainage facilities that will be required to meet the needs for a planning period five to ten years are listed and an ultimate areawide system to be provided in the time period of ten to twenty years. W71-06775

USE OF THE ICE CHANNELING PLOW FOR THE PREVENTION OF ICE BARRAGES, Defence Scientific Information Service, Ottawa

(Ontario).

Ye. N. Tykin. Available from NTIS as AD-714 413, \$3.00 in paper copy, \$0.95 in microfiche. Translation of Izvestiya Akademiy: Nauk SSSR, Geographical Series, 1970, 3, p 61-66.

Descriptors: *Ice breakup, *Rivers, *Ice jams,

*Navigation. Identifiers: *Icebreakers, *Sleds, Marine engineering, USSR, Ice barrages, Translations, *Ice channeling plows.

The development of the ice channeling plow promises a considerable simplification of the task of ice barrage prevention at points on a river where ice transit is impeded. There now appears a real possibility of eliminating dangerous ice barrages on our major rivers or in the head regions of nontransfluent forebays or reservoirs.

AREAWIDE WATER AND SEWER PLAN. Harrison City Planning Commission, Ark.

Available from NTIS as PB-194 162, \$3.00 in paper copy, \$0.95 in microfiche. Harrison City Planning Commission Comprehensive Study, Harrison, Arkansas, 1970. 20 p. HUD Project ARK P-

Descriptors: *City planning, *Sewers, *Water distribution, Water supply, *Water treatment, Water storage, Sewage treatment, Storm drums. Identifiers: Harrison (Arkansas).

The water and sewer study is based on earlier volumes of the comprehensive plan and projects public utility improvements for the planning area during the planning period. W71-06788

DRAINAGE STUDY - INVENTORY AND ANAL-

Genesee/Finger Lakes Regional Planning Board, Rochester, N.Y

Available from NTIS as PB-194 682, \$3.00 in paper copy, \$0.95 in microfiche. Technical Studies Series No 2, Regional Planning Bd, Rochester, NY, Oct 1969. 130 p, 23 ref.

Descriptors: *Watersheds (Basins), *Drainage, **Prainage programs, Rivers, Lakes, Economic impact, Surface waters, Floods, Population.

Identifiers: *Regional planning, *New York, *Genesse County (New York), *Finger Lakes Region.

The report presents an analysis of the four drainage basins within the Genesee/Finger Lakes Region which provides basic information that will be utilized in future plans and recommendations for the Region. A brief description of the area, topography, climate, population and economy in-troduces the inventory of the Lake Ontario, Genesee, Oswego and Erie-Niagara Drainage Basins. The heart of this drainage study is devoted to a detailed description of the major lakes, rivers and streams in the four drainage basins. W71-06790

SELECTION OF MATERIALS FOR SUB-SUR-FACE DRAINS.

Road Research Lab., Crowthorne (England).

Field 04-WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A-Control of Water on the Surface

Available from NTIS as PB-195 258, \$3.00 in paper copy, \$0.95 in microfiche. Road Research Laboratory Report LR 346, Crowthorne, 1970, 28 p. 15 fig. (Out of text).

Descriptors. *Sub-surface drains. *Materials. *Roads. Pipes. Drainage systems. Construction materials. Soils. Groundwater. Silts. Permeability. Porosity, Clays, Great Britain. Kennfiers. *Underground drains, Tubes, Fluid fil-

The report discusses the part played by the various components of a sub-surface drain in achieving adequate permeability and in preventing clogging of the drain by silt. Present criteria for the grading himits of the backfill and the porosity of the pipes in a drain are reviewed.

THAI AIR BASE FLOOD CONTROL, T. L. Adams, and A. C. McNulty. Military Engr., Vol 61, No 403, p 361-362, Sep-Oct 1969. I diag

Descriptors: *Flood control, *Drainage systems, *Design storm, *Reservoir storage, Runoff.

Expansion of a Royal Thai Air Force Base necesstated development of a flood control system to al-leviate drainage problems. An area-wide drainage study considered four possible solutions: (1) a concrete-lined trapezoidal channel to carry runoff around the new runway overrun; (2) a collection basin and pump near the runway; (3) a multicell box culvert under the runway extension; and (4) a flood control storage reservoir with controlled discharge. The economics and feasibility of the four plans were discussed based on a two-year design storm condition, and the storage reservoir method was decided upon. Interior base drainage consisted of a system of ditches, collection channels, and storage basins, plus three pump stations. The new flood control system will also somewhat relieve flooding of the neighboring city by decreasing the runoff rate to it.

MECHANIZATION UNDERGROUND OF DRAINAGE WORK

For primary bibliographic entry see Field 08H.

RAPID MEASUREMENT OF DRAINAGE DEN-

Kentucky Univ., Lexington. Dept. of Geography. Roger M. McCov.

Geological Society of America Bulletin, Vol 82, No 3. p 757-762, March 1971. 6 p. 4 fig. 1 tab, 7 ref.

Descriptors: *Terrain analysis, *Drainage patterns (Geologic), *Drainage density, Drainage systems, Channel morphology, Geomorphology, Estimating, Maps, Mapping, Radar, Remote sensing, Analytical techniques, Surveys, Topography, Photogram-

Identifiers: Drainage density measurement.

Investigations were made into three methods for rapid measurement of drainage density using topographic maps and radar imagery. Measurement of blue line stream symbols proves feasible but is weak due to inconsistencies. The number of intersections of streams on a random line pattern overhing a map provides a good estimate of drainage density. Edge-enhancement of radar images produces a measurable line pattern which appears to be strongly-related to total length of streams in a basin. (Knapp-USGS) W71-07010

A HYDROLOGIC MODEL OF THE BEAR RIVER BASIN.

Utah Water Research Lab., Logan. Robert W. Hill, Eugene K. Israelsen, A. Leon Huber, and J. Paul Riley.

Available from National Technical Information Service as PB-198 430, \$3.00 in paper copy, \$0.95 in microfiche. Report PRWG72-1, August, 1970. 85 p, 28 fig, 8 tab, 4 append. OWRR Project B-028-UTAH (2).

Descriptors: *Model studies, *Simulation analysis, Models, Groundwater, *Watersheds, Basins, Snowmelt, Evapotranspiration, Percolation water yield, *Hydrologic cycle, Hydrologic data, Water yield improvement, Soil moisture, *Planning, Watershed management, Hybrid computers. Identifiers: Hybrid computers.

As demands upon available water supplies increase, there is an accompanying increase in the need to assess the downstream consequences resulting from changes at specific locations within a hydrologic system. The problem is approached in this study by hybrid computer simulation of the hydrologic system. Modeling concepts are based upon the development of basic relationships which describe the various hydrologic processes. Within a system these relationships are linked by the continuity-of-mass principle which requires a hydrologic balance at all points. Spatial resolution is achieved by considering the modeled area as a series of subbasins. The time increment adopted for the model is one month, so that time varying quantities are expressed in terms of mean monthly values. The model is general in nature and is ap-plied to a particular hydrologic system through a programmed verification procedure whereby model coefficients are evaluated for the particular system. In this study the model was synthesized on a hybrid computer and applied to the Bear River basin of western Wyoming, southern Idaho, and northern Utah. Comparisons between observed and computed outflow hydrographs for each sub-basin are shown. The utility of the model for predicting the effects of various possible water resource management alternatives is demonstrated for the number 1, or Evanston subbasin. The hybrid computer is very efficient for model development, and the verified model can be readily programmed on the all-digital computer.

4B. Groundwater Management

GROUNDWATER ASPECTS OF THE LOWER HENRYS FORK REGION, EASTERN IDAHO, Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 02F.

GEOLOGY AND WATER RESOURCES OF CLAY COUNTY, SOUTH DAKOTA, PART III -BASIC DATA,

South Dakota Geological Survey, Vermillion; and Geological Survey, Washington, D.C. For primary bibliographic entry see Field 02F. W71-06501

POTENTIAL. DEVELOPMENT RECHARGE OF GROUNDWATER IN MILL CREEK VALLEY, BUTLER AND HAMILTON COUNTIES, OHIO, BASED ON ANALOG MODEL ANALYSIS,

Geological Survey, Washington, D.C. For primary bibliographic entry see Field 02F. W71-06509

THE DETECTION OF MAGNETIC FIELDS CAUSED BY GROUNDWATER AND THE CORRELATION OF SUCH FIELDS WITH WATER DOWSING.

Utah Water Research Lab., Logan. For primary bibliographic entry see Field 07B. W71-06655

RECHARGE OF AQUIFERS IN ARID ZONES AND EFFECTIVE POROSITY COEFFICIENT, M Boreli

Transactions Institute for Development of Water Resources, 'Jaroslav Cerni,' Vol 14, No 45, p 13-19, 1969, 7 p, 6 fig, 5 ref.

Descriptors: *Recharge, *Pit recharge, *Surface-groundwater relationships, *Conjunctive use, *Water storage, Analog models, Hydraulic models, Model studies, Artificial recharge, Arid lands, Water management (Applied), Reservoir leakage, Seepage, Groundwater movement, Unsteady flow. Identifiers: Yugoslavia.

The combination of surface and underground reservoirs is an attractive solution for the problems of arid zones using the surface reservoir as a storage basin for the recharge of the aquifer. The duration of surface storage ought to be as short as possible, and recharge ought to take place in the cold season when the loss of water due to evaporation is considerably smaller. Occasional drying out of the reservoir is indispensable to keep recharge rates high, especially because in warm regions biological clogging of the bottom of the reservoir is considerable and inhibits recharge. The study of intermittent recharge of aquifers is therefore of great practical importance. Several types of intermittent practical importance. Several types of intermittent recharge used in the Mediterranean littoral include some cases of lateral recharge in reservoirs with impermeable bottoms, with recharge only through the sides. Intermittent recharge of aquifers, lateral recharge and in particular intermittent lateral recharge cause a very complicated unsteady flow. Because of its simplicity the viscous fluid analog seems to be the most suitable method of study of the recharge zone. (See also W71-06704) (Knapp-W71-06705

GEOHYDROLOGIC INVESTIGATIONS IN THE MESILLA VALLEY, NEW MEXICO.

New Mexico State Univ., University Park. Dept. of Civil Engineering. For primary bibliographic entry see Field 02F.

GROUNDWATER AND WELLS.

University Oil Products, St. Paul, Minn. Johnson

St Paul, Edward E Johnson, 1966, 440 p.

Descriptors: *Water wells, *Drilling, Drilling equipment, Rotary drilling, Drawdown, Specific yield, Well hydraulics, Well screens, Corrosion, Water quality, Hydrology.

Identifiers: Groundwater regions, Well hydraulics, Groundwater exploration, Analyzing sand samples, Water well design, Well screen installation, Developing and completing wells, Disinfection, Maintaining well yield, Elements of water treatment, Well specifications, Pumps, Sanitary protection of a water supply, Groundwater conservation and utility.

The purpose of this book is to present the technical aspects of groundwater occurrence, groundwater movement, well hydraulics, well design and groundwater geology together with the practical aspects of well drilling, well screen selection, well maintenance and well operation. It describes and explains in some detail the operations that depend upon the skill of the well contractor and his drilling crews and endeavors to present practical, proven ideas. Well construction, by its very nature, is not a routine process. The variability of geologic conditions - and that of groundwater occurrence within the geologic framework - are so extensive as to make each drilling operation an exploratory undertaking, even a few tens of feet distant. The skill of the well driller that enables him to handle unforeseen situations successfully is basic to proper groundwater development. This book is an excellent source of information for the driller. (Campbell-NWWA) W71-06920

Groundwater Management—Group 4B

GROUNDWATER PRODUCTION FROM THE BEDROCK OF SWEDEN,

Craelius Terratest AB, Stockholm (Sweden) Geological Dept.
For primary bibliographic entry see Field 08A.

W71-06923

A STUDY TO EVALUATE POTENTIAL SOLU-TIONS TO THE PROBLEM OF INSURING AN ADEQUATE WATER SUPPLY FOR NEW CASTLE COUNTY, DELAWARE.

University City Science Center, Philadelphia, Pennsylvania.

For primary bibliographic entry see Field 03B. W71-06933

THE EFFECT OF HEAT ON SOME MECHANI-CAL PROPERTIES OF IGNEOUS ROCKS, Gulf Research and Development Co., Pittsburgh,

For primary bibliographic entry see Field 08E. W71-06942

DON'T POLLUTE A CLEAN RESERVOIR.

Oil and Gas Journal, Tulsa, Okla.

For primary bibliographic entry see Field 05B. W71-06943

PRINCIPLES AND PRACTICAL METHODS OF DEVELOPING WATER WELLS.

U.O.P., St. Paul, Minn. Johnson Div. For primary bibliographic entry see Field 08B. W71-06944

GEOPHYSICS AS AN AID TO THE SMALL WATER WELL CONTRACTOR.

Lansing Board of Water and Light, Mich. C. J. Linck.

Groundwater, Vol 1, No 1, p 33-37, January 1963. 6 fig. 5 ref.

Descriptors: *Borehole geophysics, *Water wells, Resistivity, Radioactivity, Seismic studies, Logging (Recording), Electric logging, Aquifer characteristics, Geophysics, Groundwater, Exploration. Identifiers: Seismic refraction exploration.

Geophysical techniques, as used in groundwater exploration are subdivided into 'bore-hole' and 'surface' methods. The former include the commonly used electrical and gamma-ray logging and the less commonly used hole calipering and current meter logging. Included with this classification, but important enough to be considered separately, is the field of water-level measurements. The surface techniques discussed include electrical resistivity and refraction seismograph exploration. Because of the type of data which they yield the surface methods are most economical where much area is to be explored and large quantities of water are needed. These factors limit the use of the techniques by small water well contractors in domestic water well work. These same contractors, on the other hand, can gain real economic advantages, in many cases, by use of one or more of the bore-hole methods. Geophysical methods properly used can do much to guide the water well contractor. It is extremely important, however, that their use be carefully directed because in the past, where geophysical methods have failed, it has often been due to the incorrect application of the technique, rather than a failure of the technique. (Campbell-NWWA) W71-06946

INTERPRETATION OF ELECTRIC LOGS IN FRESH WATER WELLS IN UNCONSOLIDATED FORMATIONS, Schlumberger Well Surveying Corp., Houston,

For primary bibliographic entry see Field 03B. W71-06947

HYDRAULIC FRACTURING,

For primary bibliographic entry see Field 08B. W71-06950

STATUTES AND REGULATIONS GOVERNING PRIVATE WATER WELL CONSTRUCTION AND PUMP INSTALLATIONS, Wisconsin State Board of Health, Madison. Well

Drilling and Sanitation Services.

For primary bibliographic entry see Field 06E. W71-06953

LOGGING DRILL CUTTINGS.

Geological Survey, Norman, Okla. J. C. Maher.

Oklahoma Geol Surv Guide Book 14, 1964, (2nd Edition). 48 p, 60 ref.

Descriptors: Sampling, *Drilling, *Oil industry, *Water wells, Cores, On-site data collections,

Logging (Recording).
Identifiers: *Drillers' logs, Drilling time logs, Electric logs, Radioactivity logs, Sample logs, Cabletool cuttings, Rotary-tool cuttings, Air-drill

This report has been prepared primarily to provide a reference, a manual, and a set of descriptive standards for subsurface investigations in the Midcontinent region. As a reference, it provides details of commonly used procedures which cannot be fully described in every subsurface report. As a manual, it should aid in orienting or training geologists in subsurface methods. As a set of descriptive stan-dards, it is hoped that it will encourage greater care and standardization in all phases of preparation of sample logs because these logs form the foundation upon which the geologic history of sedimentary basins may be reconstructed. Specifically this report describes the preparation of composite interpretive logs and presents a system of description including terminology and definitions, abbreva-tions, and symbols. General discussions of drillers logs, drilling-time logs, electric logs, radioactivity logs, and sample logs are included to explain their supporting role in preparing composite interpretive logs. It is intended to show the advantages and limitations of this method, and to define somewhat more specifically the terms that have become firmly established in subsurface work during the past 40 years and are now recorded on hundreds of thousands of well logs in oil-company and government-agency files. It is also of use to drillers to help them appreciate the primary problems of the geologist and to offer guidance in the preparation of a better driller's log. (Campbell-NWWA)

WELL DRILLING MANUAL.

Koehring Co., Enid, Okla. Speedstar Div. For primary bibliographic entry see Field 08A. W71-06956

ON THE MANAGEMENT OF GROUNDWATER IN COASTAL AQUIFERS,

North Carolina State Univ., Raleigh. Dept. of Civil Engineering. Abdel-Aziz I. Kashef.

Groundwater, Vol 9, No 2, p 12-20, March-April 1971. 9 p, 56 ref.

Descriptors: *Reviews, *Water management (Applied), *Groundwater, *Water resources development, *Saline water intrusion, Withdrawal, Drawdown, Sea water, Coasts, Aquifers. Identifiers: Coastal aquifors.

Groundwater management in coastal aquifers is an important phase in water resources especially in the operation of existing coastal wells or in planning new coastal well fields. Basic research to evaluate properly the various elements of sound management should not be overlooked. Basic research is still needed to study the roots of the problem. Aquifers should be studied as hydrogeologic units for the benefit of all interested

parties. Economic and legal decisions have to be made to establish priorities and allotments. Extensive basic research is needed in salt-water encroachment Extensive research is needed to solve many of the water recharge and leakage problems.

A SHORTCUT FOR COMPUTING STREAM DEPLETION BY WELLS USING ANALOG OR DIGITAL MODELS,

Geological Survey, Denver, Colo. For primary bibliographic entry see Field 97C. W71-07006

GROUNDWATER **FLUCTUATIONS** RESPONSE TO ARBITRARY PUMPAGE,

Illinois State Water Survey, Urbana. For primary bibliographic entry see Field 02F. W71-07007

WELLS AND SPRINGS IN CALIFORNIA AND NEVADA WITHIN 100 MILES OF THE POINT 37 DEGREE 15' N., 116 DEGREE 25'W., ON NEVADA TEST SITE,

NEVADA 1EST STIE; Geological Survey, Denver, Colo. William Thordarson, and B. P. Robinson. Available from the National Technical Information Service as USGS-474-85, \$3.00 in paper copy. S0.95 in microfiche. Geological Survey Report USGS - 474-85, 1971. 178 p, 4 fig. 8 tab, 77 ref. USAEC Agreement No AT (29-2)-474.

Descriptors: *Data collections, *Hydrologic data, *Nevada, *Wells, *Springs, Reviews, Nuclear explosions, Water yield, Damages, Legal aspects, Groundwater, Aquifers, Hydrogeology, Alluvium. Identifiers: *Nevada Test Site.

Studies of published and unpublished geologic and groundwater data were reviewed for an inventory of 6,032 wells and 754 springs in parts of lnyo and Mono Counties, California, and Clark, Esmeralda, Lincoln, and Nye Counties, Nevada. A complex sequence of granitic, metamorphic, volcanic, and sedimentary rocks of Precambrian to Holocene age are present in the study area. The valley fill alluvi-um is the best aquifer. The carbonate and the volcanic rocks produce small to large amounts of water from fractures or solution cavities. The clastic rocks and the metamorphic and granitic rocks produce very little groundwater. The greatest concentration of wells in the study area is in the Las Vegas area, which has 79% of the total wells inventoried. The Las Vegas area has less than 1% of the springs inventoried. The major uses of groundwater listed in order of abundance, for the area exclusive of Las Vegas, are irrigation, domestic, public supply, and industrial. The major uses of groundwater listed in order of abundance in the Las Vegas area are domestic, irrigation, public supply, and commercial. (Knapp-USGS) W71-07029

PUMPAGE AND GROUNDWATER STORAGE DEPLETION IN CUYAMA VALLEY, CALIFOR-NIA. 1947-66.

Geological Survey, Menlo Park, Calif. John A. Singer, and W. V. Swarzenski. Geological Survey Open-file Report, August 3, 1970. 22 p. 7 fig. 3 tab, 9 ref.

Descriptors: *Groundwater, *Overdraft. *Recharge. *California, *Water resources development, Aquifers, Hydrogeology, Pumping, Withdrawal, Drawdown, Water levels, Water level fluctuations, Water quality, Water table, Water utilization, Irrigation.

Identifiers: *Cuyama Valley (Calif).

Water-level declines of as much as 160 feet have occurred in the Cuvama Valley since 1947. The 1947-66 overdraft is estimated at 21,000 acre-feet annually and is causing a water-level decline from 2 to 8 feet per year over an area of about 35,000

Field 04-WATER QUANTITY MANAGEMENT AND CONTROL

Group 4B-Groundwater Management

acres. Most of the groundwater body is unconfined, but groundwater movement is restricted by fault-ing. About half of the current natural groundwater ing. About half of the current natural groundwater recharge is used in the valley, and the other half is lost by evapotranspiration. Groundwater quality is only fair and is gradually becoming worse as water from irrigated land returns to the water table. In many areas of the valley imported water could be successfully recharged to the groundwater basin by spreading in surface-recharge basins. Recharging might be most beneficial where permeable deposits have a large unsaturated storage capacity. (Woodard-USGS) W71-07039 W71-07039

WATER WELL EXPLOSIONS: AN ENVIRON-MENTAL HAZARD,

Pennsylvania State Univ., University Park. Coll. of Earth and Mineral Sciences.
D. P. Gold, R. R. Parizek, and T. Giddings.
Earth and Mineral Sciences, Vol 40, No 3, p 17-19,
December 1970. 3 p, 5 fig, 12 ref.

Descriptors: *Water wells, *Domestic water, *Explosions, *Pennsylvania, Thunderstorms, Lightn-ing, Electric motors, Gases, Evaluation. Identifiers: *Water-well explosion.

During a thunderstorm on June 12, 1970, an explosion in a water well in the yard of a private dwelling (14 miles east of State College, Pennsylvania) demolished a concrete pump house and excavated a crater 25 feet across. The explosion threw debris hundreds of feet into the air, and the pump itself (200 lb) cleared the adjacent trees and a 38-foot high power line and landed in the field across the highway, 179 feet away. From the geologic setting and landuse, the type of explosive can be narrowed down to a gas accumulation from either (1) a flammable pollutant, (2) decomposed organic material, or (3) fossil gas or petroleum. The cause of this explosion may never be determined, but the presence of a flame reported by an eyewitness and the lack of burn marks in the crater suggest an ex-plosion deep within the well shaft. (Woodard-USGS) W71-07040

4C. Effects on Water of Man's Non-Water **Activities**

SUBURB MEETS URBANIZATION HEAD-ON. For primary bibliographic entry see Field 05D.

URBAN PLANNING ASPECTS OF WATER POLLUTION,

For primary bibliographic entry see Field 05G.

THE QUALITY OF URBAN DRAINAGE,

For primary bibliographic entry see Field 05B. W71-06575

HYDROLOGICAL AND ENVIRONMENTAL CONTROLS ON WATER MANAGEMENT IN AN ARID URBAN AREA, Arizona Water Resources Research Center, Tuc-

Sol D. Resnick, and Kenneth J. DeCook

Paper, American Association for the Advancement of Science, Annual Meeting, Chicago, Illinois, December 1970. 16 p, 1 fig, 1 tab, 10 ref. OWRR Project B-012-ARIZ (2).

Descriptors: *Recreation facilities, *Urbanization, *Flood protection, *Watershed management, *Environmental effects, Water conservation, Dry seasons, Coliforms, Decision making, Planning, Control, Chemical oxygen demand, Economic feasibility, Recharge, Domestic water, Activated carbon, Irrigation water, Water requirements, Chlorination, Turbidity, Runoff, Rainfall, Data collections, Simulation analysis, Mathematical models, Water management (Applied), Water models, Water management (Applied), Water quality. Water reuse, Treatment, Storm runoff, Flood damage, Flood control, Flood plains, Convection, Water levels, Arizona, Water wells, Arid lands.

Identifiers: *Greenbelts, *Rainfall-runoff-water quality process, *Urba watershed, Alum, Tucson. *Urban watershed, *Rural

Southwestern arid cities are rapidly growing. Additional wells, which support subdivisions, grassed medians, parks and water-based recreation, contribute to perennial water-level declines. Storm sewers are usually nonexistent. Vehicles may be washed away, and urbanites may drown during summer convective storms. A more reasonable urban plan includes: (1) allow homes only outside flood plains; (2) create greenbelts along channels; (3) manage storm runoff to reduce peaks, provide storage, treatment and reuse; and (4) depress medians. Field data from urban areas, regarding storm volumes and intensities, and runoff quality and quantity, are urgently needed to manage storm water. Mathematical models and simulations for analyzing rainfall-runoff-water quality processes need to be developed, refined and applied. Data is being collected on 3 urban and 2 rural watersheds in Tucson by the University of Arizona as a data base. About 2 1/2% of the rainfall becomes runoff in the rural watersheds. Urban runoff is low in turbidity, which may be reduced by alum, and high in COD and fecal coliforms, particularly after sustained dry periods. Chlorination would allow irrigation or water-contact recreation. Activated carbon process, before chlorination, would allow domestic use. Future work includes detailed rainfall and runoff water-quality analysis, treatment, storage and recharge studies, economic analysis and pilot studies. (Popkin-Arizona) W71-06597

DRAINAGE OF ROADS AND PAVED SUR-

M. J. Hamlin, and F. D. Hobbs. Inst. of Public Health Engrs, Vol 69, Part 2, p 122-141, Apr 1970.

Descriptors: *Rainfall intensity, *Storm drains, Hydraulic design, Roads. Identifiers: *Stormwater inlets.

Factors to be considered in designing stormwater inlets for roads are discussed utilizing hydraulic requirements rather than a purely empirical viewpoint. Rainfall intensity is one determining factor since, theoretically, rainfall intensity is a function of the area to be drained. The intensity of rainfall and the period for which it lasts varies across the country, and therefore, this factor must be carefully evaluated before designing stormwater inlets. W71-06626

EFFECTS OF URBAN DEVELOPMENT ON FLOODS IN NORTHERN VIRGINIA. Geological Survey, Washington, D.C.

Daniel G. Anderson.

For sale by Superintendent of Documents, US Government Printing Office, Washington, D.C. 20402, 25 cents. Geological Survey Water-Supply 2001-C, 1970. 22 p, 5 fig, 5 tab, 10 ref.

Descriptors: *Rainfall-runoff relationships, *Urbanization, *Flood damage, *Virginia, *District of Columbia, Erosion, Watersheds (Basins), Hydrologic data, Floods, Mathematical studies, Geomorphology, Streamflow, Precipitation (Atmospheric), Land use, Effects, Peak discharge, Drainage, Runoff, Drainage systems, Planning, Sediment transport, Flood forecasting, Hydrograph

Identifiers: *Urban Hydrology, Northern Virginia.

Graphical and mathematical relations presented to estimate the flood-peak magnitudes having recurrence intervals ranging up to 100 years for drainage basins with various degrees of urban or suburban development. Five independent variables are required for use of the relations. They are the size, length, and slope of the basin, which may be measured from maps, and the percentage of imper-vious surface and type of drainage system, which who surface and type of drainage system, which may be evaluated by a basin inspection but in actual practice will usually be estimated for future developed conditions. Based upon analysis of flood information for 81 sites, 59 of which are in the Washington, D.C., metropolitan area, the relations should be useful for design of drainage systems and for definition of flood limits. The relations presented are applicable only to the Washington, D.C., area, but the method of analysis is general and may be used for any area where the major floods result from rainfall. Urban and suburban development affect floodflows significantly. Improvements of the drainage system may reduce the lag time to one-eighth that of the natural channels.

This lag-time reduction, combined with an increased storm runoff resulting from impervious surcreased storm runoff resulting from impervious surfaces, increases the flood peaks by a factor that ranges from two to nearly eight. The flood-peak increase depends upon the drainage-basin characteristics and the flood recurrence interval. (Woodard-USGS)
W71-06690

ANNOTATED BIBLIOGRAPHY ON SNOW AND ICE PROBLEMS.

Toronto Univ., Ontario, Canada. Dept. of Geog-

For primary bibliographic entry see Field 02C. W71-06719

CONSERVATION PROGRAMS IN THE URBAN

FRINGE, John W. Neuberger. J Soil Water Conserv, Vol 24, No 6, p 216-618, Nov/Dec 1969. 6 ref.

Descriptors: *Conservation, *Storm drains, *Drainage, Erosion control, Runoff, Sediment control, Nebraska, Urbanization, Water pollution con-

Solutions to land erosion and drainage problems caused by suburban sprawl in a Nebraska conservation district are outlined. Increased paving, roofing, and compacted soils result in erosion and flooding; therefore, the construction of major and minor storm drainage and water runoff systems is recommended. An Omaha program to reduce sedimentation from developing areas is detailed in addition to guidelines for good land resource conservation. Examples of developers' initiatives towards furthering the urban conservation program are cited. W71-06751

RIVER ENGINEERING AND WATER CONSER-VATION WORKS,

For primary bibliographic entry see Field 05G. W71-06771

THE USE OF BALANCING RESERVOIRS AND FLOW REGULATING RESERVOIRS IN DEAL-ING WITH RUN-OFFS FROM URBAN AREAS, For primary bibliographic entry see Field 05G W71-06772

URBAN ECONOMICS AND PLANNING, VOLUME I, A DDC BIBLIOGRAPHY. Defense Documentation Center, Alexandria, Va.

Available from NTIS as AD-714 500, \$3.00 in paper copy, \$0.95 in microfiche. DDC-TAS-70-73-1, Cameron Station, Alexandria, Va, Oct 1970. 235 p with index.

Identification of Pollutants—Group 5A

Descriptors: *City planning, *Urbanization, *Social aspects, Bibliographies, *Economics, Cost allocation, Urban renewal, Transportation.
Identifiers: *Urban planning, Sociometrics, Water

pollution.

The bibliography includes annotated references to reports on urban area problems, regional planning and development, sociometrics, urban renewal, transportation, traffic, noise and communications. Corporate author-monitoring agency, and subject, indexes are included. W71-06777

EFFECT OF A COMMERCIAL CLEAR-CUTTING IN WEST VIRGINIA ON OVERLAND FLOW AND STORM RUNOFF, Kenneth G. Reinhardt.

J Forest, Vol 62, No 3, p 167-171, 1964.

*Rainfall-runoff relationships, *Watershed management, Watersheds (Basins), Overland flow, Storm runoff, West Virginia, Infiltration, Hydrologic aspects.
Identifiers: Experimental watersheds.

A commercial clearcutting was made on a 74-acre gaged watershed on the Fernow Experimental Forest; skidroads were loggers' choice--without limitations as to grade or provisions for drainage.

After-logging infiltration rates in the watershed remained well maximum rainfall intensities except on portions of the skidroads. Overland flow occurred only from the skidroads; it resulted from the combination of rain directly on the skidroads and interception of subsurface flow by the road cuts. Increased storm runoff in the growing seasons--up to a maximum of about 1/2 area-inch in any one storm--was largely the result of decreases in fieldmoisture deficiency rather than changes in the pro-portions of surface and subsurface flow. This study portions of surface and subsurface flow. This study indicates that, in judging hydrologic condition of logged areas, perhaps as much emphasis should be placed upon road conditions and forest-floor disturbance as upon the amount of timber cut and condition of the stand.

W71-06970

4D. Watershed Protection

CONTROL OF SEDIMENT FLOW INTO SUB-

SURFACE DRAINS,
Ohio Agricultural Research and Development Center, Columbus; and Agricultural Research Service, Columbus, Ohio. Soil and Water Conservation Research Div.

Om P. Gulati, Glenn O. Schwab, and Ronald C.

ASCE Proceedings, Journal of the Irrigation and Drainage Division, Vol 96, No IR 4, p 437-449, December 1970. 13 p, 10 fig, 1 tab, 8 ref, append.

Descriptors: *Subsurface drains, *Tile drains, Sediment control, Velocity, Sediment transport, Sedimentation, Silting, Filters, Sands, Analog models, Hydraulic models.

Identifiers: Drain sedimentation.

Sediment inflow into subsurface drains in noncohesive soils may be alleviated by using an impervious cover over a drain having inflow openings only at the top. Water flows between the cover and the outer drain surface in an upward direction before entering the openings at the top of the drain. Sediment inflow is prevented if the flow velocity is less than the critical boiling velocity. In this paper the shape of the upflow channel openings and the velocity distribution across the openings are evaluated. Terzaghi's concept of effective stress is the basis for the theoretical velocity distribution. An basis for the theoretical velocity distribution. An electric analog model was employed to verify this theory. A laboratory model was used to determine critical velocities. Critical boiling velocities for fine sand and glass beads are about 1% of Stoke's settling velocity. Within reasonable limits the upflow channel width and shape can be designed to prevent movement of sediment. High water tables have the greatest influence on velocity. (Knapp-W71-06500

ERROR ANALYSIS AND SYSTEM IDENTIFI-ERROR ANALYSIS AND SYSTEM IDENTIFICATION OF WATER BALANCE AND THE RAINFALL EXCESS COMPONENT IN REAL AND MODEL WATERSHEDS, Arizona Univ., Tucson. Dept. of Hydrology and

Water Resources.

For primary bibliographic entry see Field 06A. W71-06578

SYSTEMS THEORY: A NEW APPROACH FOR MODELLING WATERSHEDS REALISTI.

CALLY, Arizona Univ., Tucson. Dept. of Hydrology and Water Resources

For primary bibliographic entry see Field 06A. W71-06579

EXPERIMENTAL PROGRAM FOR ANALYSIS AND VALIDATION OF WATERSHED MODELS, Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

For primary bibliographic entry see Field 06A. W71-06580

05. WATER OUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

ATMOSPHERIC TECHNETIUM-99.

East Texas State Univ., Commerce. Dept. of Chemistry.

Moses Attrep, John A. Enochs, and Larry D. Broz. Environmental Science and Technology, Vol 5, No 4, p 344-345, April 1971. 2 p, 1 tab, 4 ref.

Descriptors: *Trace elements, *Rain water, *Radioisotopes, *Radiochemical analysis, Test procedures, Atmosphere, Water chemistry. Identifiers: *Technetium-99.

Technetium-99 was isolated from 13 rain samples collected in 1967. The sizes of these samples were 53.5 to 233 liters. The concentrations of Tc-99 varied from 0.14 X 10 to the minus 2 to 1.7 X 10 to the minus 2 pCi/liter. Radioactive measurements were conducted on a Tracerlab Omniguard Low Level Beta Counter. The background of the counting system was about 0.3 cpm. Identification of the Tc-99 activity is based on indirect evidence. The observed activity in the rain samples followed the chemistry of technetium. Because the activities of these samples were low, and the half-life is so long, customary identification is impossible. Samples were counted for over two years with no decrease in activity. Since the availability and use of this fission produced nuclide have increased in recent years, Tc-99/is becomming widespread both in the atmosphere and in the natural water system.
(Woodard-USGS) W71-06457

CONTINUOUS MONITORING OF WATER SUR-FACES FOR OIL FILMS BY REFLECTANCE MEASUREMENTS,

Shell Development Co., Emeryville, Calif. Alvin D. Goolsby.

Environmental Science and Technology, Vol 5, No 4, p 356-357, April 1971. 2 p, 3 fig, 1 ref.

Descriptors: *Oil, *Oil-water interfaces, *Monitoring, *Oil wastes, *Water pollution sources, Laboratory tests, Test procedures, Light, Refractivity, Prototype tests, Effluent streams, Industrial wastes. Identifiers: *Oil film monitoring.

Laboratory experimentation and plant tests show that the use of reflectance measurement is a promising means of continuously monitoring water promising means of continuously monitoring water surfaces for oil contamination. The instrument resulting from these experiments in both simple and sensitive and can be used as a qualitative analyzer which would sound an alarm if oil slicks of significant size are detected. A laboratory arrangement consisting of an incandescent lamp, collimating lens, and photodetector was used to generate a light beam incident on a water surface and to measure the intensity of the reflected beam. The measure the intensity of the reflected beam. sure the intensity of the reflected beam. The measured average intensity, using an angle of incidence of 30 deg increased 100% when a drop of 'waste oil' was introduced on the water. The actual intenoil' was introduced on the water. The actual intensity increase is significantly greater than the calculated value. This is possibly due to multiple internal reflections and light absorption in the oil film because thin films of oil on water give rise to more reflected light than very thick films. A prototype oil film monitor was constructed for tests of the reflectance principal in a refinery effluent stream. (Woodard-USGS) W71-06459

DIELDRIN AND ENDRIN CONCENTRATIONS IN A LOUISIANA ESTUARY, Ogden Coll. of Science and Technology, Bowling Green, Ky, and Oklahoma Univ., Norman. Dept. of Civil Engineering and Environmental Science; and Franklin Inst., Boston, Mass; and Riverside Research Labs., La Chasse, La. For primary bibliographic entry see Field 05B. W71-06460

CHLORINATED HYDROCARBON PESTICIDES IN IOWA RIVERS, lowa Univ., lowa City. State Hygienic Lab.

For primary bibliographic entry see Field 05B. W71-06461

THE QUANTITY, COMPOSITION AND DISTRIBUTION OF SUSPENDED PARTICULATE MATTER IN THE GULF OF CALIFORNIA, Scripps Institution of Oceanography, La Jolla,

Calif B. Zeitzschel.

Marine Biology, Vol 7, No 4, p 305-318, December 1970. 14 p, 15 fig, 6 tab, 48 ref. Bur Commercial Fisheries Contract 14-17-0007-963.

Descriptors: *Suspended load, *Seston, *Sea water, Organic matter, Silts, Sediment load, Suspension, Primary productivity, Nutrients, Instrumentation, Mineralogy, Plankton, Analytical techniques, Sampling.
Identifiers: *Gulf of California.

The quantity and quality of suspended particulate matter were estimated in 34 samples from the euphotic zone of 9 stations in the Gulf of California. The results from electronic, microscopic and chemical analyses showed that most parameters measured were significantly correlated. The total particulate volume from particles of 2 to 150 microns diameter, as obtained from the Coulter Counter, were significantly related to such parameters as seston, particulate nitrogen, particulate car-bon, phytoplankton carbon and chlorophyll a. The Coulter Counter can be a very useful instrument to determine, with little effort, the size, distribution, and volume of particulate suspended matter in the important biological parameters which are necessary to establish meaningful models of phytoplankton production. (Knapp-USGS)
W71-06494 sea. These data can then be used to calculate some

STABLE CARBON ISOTOPE RATIOS AS INDICES OF PETROCHEMICAL POLLUTION OF AQUATIC SYSTEMS,

Texas Univ., Port Aransas. Inst. of Marine Science.
John A. Calder, and Patrick L. Parker.

Environmental Science and Technology, Vol 2, No 7, p 535-539, July 1968. 5 p, 2 fig, 4 tab, 10 ref. NSF Grants GA-299 and GA-911.

Group 5A-Identification of Pollutants

Descriptors: *Pollutant identification, *Water pollution sources, *Stable isotopes, *Oil wastes, *Surlution sources, "Stable Isotopes, "On Wastes, "Surface waters, Carbon, Organic matter, Oil industry, Oily water, Streams, Texas, Analytical techniques, Methodology, Spectrophotometry, Water quality. Identifiers: *Carbon isotope ratios.

Variations in the C-13/C-12 ratio of dissolved and particulate organic matter from several aquatic systems were investigated. These measurements were made for natural and organic chemically polluted systems. Delta C-13 natural systems ranges between -14 and -23 relative to the National Bureau of Standards isotope reference material No. reau of Standards isotope reterence material No. 20. Petrochemical products and petrochemical effluents are much more depleted in C-13 with a range from -25 to -49. Delta C-13 of the dissolved organic matter was measured for 15 samples from the Houston, Tex., Ship Channel. Model calculations based on these data suggest that the C-13/C-12 ratio of dissolved organic matter may serve as a quantitative index of petrochemical pollution. The studies described are the test of the idea that stable isotope ratios may serve as a useful index of organic pollution of aquatic systems. The data suggest that this is the case. (Woodard-USGS)

THE PATUXENT RIVER, REPORT NO 4, PHYSICAL, CHEMICAL AND BACTERIOLOGICAL WATER QUALITY - SUMMER SURVEYS,

1964-1966, Maryland Dept. of Water Resources, Baltimore. Div. of Water Quality Investigations. For primary bibliographic entry see Field 05B. W71-06516

OHIO RIVER VALLEY WATER SANITATION COMMISSION: SEVENTEENTH, EIGHTEENTH, NINETEENTH, AND TWENTIETH YEARBOOKS.

For primary bibliographic entry see Field 05G. W71-06564

PROPOSED PROCEDURE FOR DETERMINING QUANTITY AND QUALITY OF STORM FLOW, M. B. Fielding.

Water Resources Comm, Div Res Pap No 2002, 1966.

Descriptors: Measurement, Flow, Planning. Identifiers: *Storm sewage, Suspended solids.

The author outlines a suitable procedure for measuring the flow of storm sewage and for collecting samples for the determination of BOD and suspended solids. A graphical form is proposed for reporting the results. W71-06566

WATER QUALITY MONITORING FIELD STU-DIES,

Bruce R. Barrett

Paper presented at the Calif Water Pollution Control Assoc 42nd Annual Conference, Sacramento, Calif, April 29 to May 1, 1970.

Descriptors: *Monitoring, *On-site investigations, *Instrumentation, Water pollution, Sources, Water

Continuous water quality monitors have been used by the Technical Services Program of the Robert S. Kerr Water Research Center, Ada, Oklahoma, in a variety of field water pollution studies and for various purposes. Two commercially available types of monitors have been used. Monitors were used in the James River Project along with recording flow gages to determine the relationship between stream quality and storm runoff. In a before-and-after type study to determine differences in quality due to navigation impoundments, monitors were used to establish the existing quality of the waterway. In a research study of a refinery waste treatment plant, a monitor was used to study the various unit processes for purposes of treatment control and overall refinery waste monitoring. The sample taking capability of the monitors was indispensable in an enforcement case involving a mine waste.

FECAL COLIFORM CONCENTRATIONS IN STORMWATERS,

For primary bibliographic entry see Field 05B. W71-06570

SEASONAL VARIATIONS IN SURVIVAL OF INDICATOR BACTERIA IN SOIL AND THEIR CONTRIBUTION TO STORMWATER POLLU-

For primary bibliographic entry see Field 05B. W71-06571

THE BACTERIOLOGICAL ASPECTS OF STORM-WATER POLLUTION,
For principle bibliographic entry see Field 05B. W71-06572

WATER QUALITY AT PATUXENT RIVER BRIDGE, MARYLAND - JANUARY 1968 THROUGH NOVEMBER 1969,

Geological Survey, Arlington, Va. Robert L. Cory, and Jon W. Nauman. Geological Survey Open-file Report, 1971. 51 p. 8 fig, 1 tab, 16 ref.

Descriptors: *Water quality, *Estuaries, *Maryland, *Monitoring, Hydrological data, Data collections, Sampling, Stream gages, Water level fluctuations, Primary productivity, Water pollution effects, Nutrients, Sewage, Water pollution sources, Thermal pollution, Tides, Dissolved oxygen, Tur-

Identifiers: *Patuxent Estuary (Md).

An 8-parameter water quality monitor was operated on the Patuxent estuary, Maryland, from October 1963 to December 1969. Surface temperatures over the entire period ranged from -1.1 deg to 32.0 deg C. The effects of thermal discharges from a steam electric station located 6.5 KM upstream were slight and detectable only during the late phase of the ebb tide. The lowest annual average salinity was recorded during 1968. The 1969 salinity record was unusual in that no springtime low in salinity occurred because of an early spring rainfall deficiency. Turbidity ranged from about 7 to 170 JCU. Diurnal records of dissolved oxygen in the summer of 1968 and 1969 reflected the oxygen produced by phytoplankton stimulated from upstream domestic waste discharges. Average daily gross primary plant production increased 20%. The mean range of tide was 1.9 feet with an extreme range of 6.1 feet during 1968 and 1969 as compared to 6.7 for the 4 previous years. (Knapp-USGS) W71-06664

MERCURY CONTENT OF ILLINOIS COALS,

Illinois State Geological Survey, Urbana. R. R. Ruch, Harold J. Gluskoter, and E. Joyce Kennedy.

Illinois Geological Survey Environmental Geology Notes, No 43, February 1971. 15 p, 6 fig, 4 tab, 7

Descriptors: *Pollutant identification, *Heavy metals, *Trace elements, *Coals, Coal mines. Pyrite, Methodology, Analytical techniques, Chemical analysis, Laboratory tests, Mineralogy. Neutron activation analysis. Identifiers: *Mercury.

Fifty-five raw coal samples from 10 coal seams in Illinois have a mean mercury concentration of 0.18 part per million and a mode that lies between 0.10 ppm and 0.12 ppm. Eleven coal samples from states other than Illinois have mercury concentrations within the same range as Illinois coals, or slightly lower. The neutron activation method used

for the determination of mercury in coal. developed at the Illinois State Geological Survey, has a sensitivity of approximately 0.0! ppm and a precision of about 20 percent. Three coal samples were individually separated into specific gravity fractions in the laboratory, and all exhibited a mercury reduction of at least 50 percent in the lightest coal fraction and a concentration of mercury in the heaviest fraction. A more detailed study of a single coal sample suggests that a significant part of the mercury is associated with the pyrite in the coal, and the remainder (perhaps up to 50 percent) is in organic association. (Woodard-USGS) W?1-06666

RECONNAISSANCE OF SELECTED MINOR ELEMENTS IN SURFACE WATERS OF THE UNITED STATES, OCTOBER 1970, Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 07C W71-06670

ANALYTICAL PROCEDURES FOR MEASUR-ING CHEMICALS IN THE PUBLIC HEALTH SERVICE DRINKING WATER STANDARDS,

For primary bibliographic entry see Field 05F.

QUANTITIES AND CHARACTERISTICS OF FARM-ANIMAL WASTES, Public Health Service, Chicago, Ill. Bureau of Solid

Waste Management.
For primary bibliographic entry see Field 05G.

W71-06812

AESTHETICS AND ODORS,

Wisconsin Dept. of Natural Resources, Madison. For primary bibliographic entry see Field 05G. W"1-06814

DETERMINATION OF SOME CHEMICAL AND PHYSICAL RELATIONSHIPS FROM RECORD-ING METERS IN LAKES,

Ontario Water Resources Commission, Toronto Mery D. Palmer, and J. Bryan Izatt. Water Research, Vol 4, No 12, December 1970, 14 p, 6 fig. 9 tab, 9 ref. p 773-786.

Descriptors: *Path of pollutants, *Monitoring.
*Water quality, *Lakes, *Lake Erie, Water pollution sources, Water pollution effects, Pollutanthastrumentation, Statistical methods, Current meters, Dissolved oxygen, Hydrogen-ion concentration.
Identifiers: *Water quality monitoring

Hourly readings of current, conductivity, pH and dissolved oxygen were collected during May and June, 1969, 1.6 km offshore at the mid-depth of a total depth of 6 m on Lake Erie. The nearest major sewage outfall is 6 km to the west of the measuring location. Data collected in this manner requires extensive conditioning before meaningful time series analytical techniques are applied. Conductivity was found to correlate directly with water movement in the nearshore areas of lakes, and is considered to be transported by the currents, pH was related to currents for one month only. Dissolved oxygen is independent of currents and requires information other than currents to explain the measured values. Probability techniques were successfully used to describe conductivity, pH and dissolved oxygen. (Knapp-USGS)
W71-07045

A COLORIMETRIC METHOD FOR AMMONIA

IN NATURAL WATERS.
Council for Scientific and Industrial Research, Pretoria (South Africa). National Inst. for Water Research.

J. E. Harwood, and A. L. Kuhn.
Water Research, Vol 4, No 12, p 805-811,
December 1970, 7 p, 1 fig, 2 tab, 22 ref.

Sources of Pollution—Group 5B

Descriptors: *Chemical analysis, *Water analysis, *Colorimetry, *Nitrogen, *Ammonia, Pollutant identification, Trace elements, Water pollution, Water quality.
Identifiers: *Ammonia determination.

An improved phenol-hypochlorite method for determining ammonia in water uses nitroprusside as catalyst. The method is simple, sufficiently sensitive for low-level analyses and does not require accurate time intervals between reagents, nor expensive equipment. The method is well suited for routine use. Beer's Law was obeyed over the whole ammonia range investigated. Reproducibility was 1.3 percent with 10 micrograms N and 5.7 percent with 1 microgram N. (Knapp-USGS)

5B. Sources of Pollution

TRITIUM LOSS FROM WATER EXPOSED TO THE ATMOSPHERE.

Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.

For primary bibliographic entry see Field 02K. W71-06456

CONTINUOUS MONITORING OF WATER SUR-FACES FOR OIL FILMS BY REFLECTANCE MEASUREMENTS.

Shell Development Co., Emeryville, Calif. For primary bibliographic entry see Field 05A.

DIELDRIN AND ENDRIN CONCENTRATIONS IN A LOUISIANA ESTUARY, Ogden Coll. of Science and Technology, Bowling

Ogden Coll. of Science and Technology, Bowling Green, Ky, and Oklahoma Univ., Norman. Dept. of Civil Engineering and Environmental Science; and Franklin Inst., Boston, Mass; and Riverside Research Labs., La Chasse, La. D. R. Rowe, L. W. Canter, P. J. Snyder, and J. W.

Pesticides Monitoring Journal, Vol 4, No 4, p 177-183, March 1971. 7 p, 3 fig, 7 tab, 10 ref. PHS Grant No 1 RO 1 UI 00346-01.

Descriptors: *Estuaries, *Louisiana, *Dieldrin, *Endrin, *Pesticide residues, Bottom sediments, Water quality, Bioassay, Water pollution sources, Mississippi River.

Identifiers: *Mississippi River Delta.

The endrin and dieldrin concentrations were determined in water, bottom sediment, and oysters in an ducted in water, bottom sediment, and objects in an estuarine area of Louisiana. Sampling was conducted on approximately a semimonthly basis from October 1968 through May 1969 in Grand Bayou, Hackberry Bay, and Creole Bay. Creole Bay is about 14 miles above the Gulf of Mexico. Samples of oysters, sediment, and water were analyzed for residues of dieldrin and endrin using electron capture gas chromatography. Identification was made first on a nonpolar column and then on a polar column. The median concentration of dieldrin and endrin in oysters was 1.3 ppb and less than 1 ppb, respectively, while the maximum concentration was 3.4 ppb and 2.4 ppb. Water samples from all stations on every sampling date contained less than I ppb of both dieldrin and endrin; the highest level of dieldrin detected in the bottom sediment was 4 ppb, and the maximum concentration of endrin was less than 5 ppb. (Knapp-USGS) W71-06460

CHLORINATED HYDROCARBON PESTICIDES IN IOWA RIVERS,

Iowa Univ., Iowa City. State Hygienic Lab. Lauren G. Johnson, and Robert L. Morris. Pesticides Monitoring Journal, Vol 4, No 4, p 216-219, March 1971. 4 p, 4 tab, 9 ref.

Descriptors: *Chlorinated hydrocarbon pesticides, *Iowa, *Rivers, Dieldrin, DDT, Pesticide residues, Path of pollutants, Water pollution sources, Ru-noff, Mississippi River Basin. The routine monitoring of a number of lowa rivers for chlorinated hydrocarbon pesticides over a 3year period has shown the presence of dieldrin, DDT, or DDE in the majority of the samples taken. Dieldrin has occurred more frequently and in higher concentrations than either of the other residues, and this is attributed to the amount of agricultural activity in the watersheds involved and to the amount of surface water runoff. (Knapp-W71-06461

MONITORING ECOLOGICAL CONDITIONS ASSOCIATED WITH WIDE-SCALE APPLICA-TIONS OF DMA 2,4-D TO AQUATIC ENVIRON-

Tennessee Valley Authority, Muscle Shoals, Ala. Div. of Environmental Research. T. A. Wojtalik, T. F. Hall, and Larry O. Hill. Pesticides Monitoring Journal, Vol 4, No 4, p 184-

203, March 1971. 20 p, 4 fig, 14 tab, 12 ref, 4 ap-

Descriptors: *Herbicides, *Pesticide residues, *Reservoirs, *Alabama, *Tennessee, Aquatic weed control, Water quality, Bioassay, Water pollution sources, Tennessee River, Tennessee Valley Authority Project.

Identifiers: Eurasian Milfoil, Nickajack Reservoir, Gunterville Reservoir.

Over 18,000 surface acres of Nickajack and Gunterville Reservoirs, Alabama and Tennessee, were treated with about 170,000 gallons dimethlamine salt of 2,4-D during April-June 1969 to control invading Eurasian watermilfoil. The DMA 2,4-D was applied at the rates of 20 and 40 lb of 2,4-D acid equivalent per acre. Representative habitat types were selected and monitored for 2.4-D content in water, plankton, and sediment and for plankton species composition, distribution, abundance, change, and response. The treated water had no apparent effects on most marginal plants. No harmful response to the herbicide was observed in zooplankton, phytoplankton, benthic macroinvertebrates, or fish. Water continued to be used for domestic purposes without user complaints. Dimethlamine salt of 2,4-D appears to be noncumulative. Plankton sorbed large amounts and retained it for extended periods. Finished drinking water from municipal treatment plants on occasion contained 2,4-D. (Knapp-USGS) W71-06462

THE DECOMPOSITION OF CRUDE OIL RESIDUES IN SAND COLUMNS, Marine Lab., Aberdeen (Scotland).

R. Johnston.

Journal Marine Biology Association of the United Kingdom, Vol 50, No 4, p 925-937, 1970. 13 p, 5 fig, 8 ref.

Descriptors: *Oily water, *Beaches, *Sands, *Biodegradation, Path of pollutants, Water pollution effects, Surf, Oxidation, Model studies, Laboratory tests. Identifiers: *Oil spills, *Oily beaches.

Rates of oxygen uptake were measured at a range of depths in sand columns (1) without oil, (2) heavily oiled and (3) lightly oiled. Oxygen change in presence of oil indicates the response of the microbial population and provides an estimate of the rate of biological degradation of the crude oil. Breakdown is dominated by oxygen availability but nutrients contribute as auxiliary oxygen sources. Oxygen removal indicates initial rates of oxidation of oil at 10 deg C ranging from 0.09 g oil per sq m per day for heavily dosed sand to 0.04 g oil per sq m per day for lightly dosed sand. These rates are applicable over periods of several months, thereafter the remaining oil, about 90%, decays immeasurably slowly. (Knapp-USGS)

GEOHYDROLOGY OF THE SHALLOW AQUIFERS OF BATON ROUGE, LOUISIANA, Louisiana State Univ., Baton Rouge. Resources Research Inst.
For primary bibliographic entry see Field 02F.

INORGANIC PHOSPHATE TRANSFORMA-TION IN WATERLOGGED SOILS.

Louisianna State Univ., New Orleans.
I. C. Mahapatra, and W. H. Patrick, Jr. Soil Science, Vol 107, No 4, p 281-288, 1969. 8 p.

Descriptors: *Water pollution sources, *Soil treatment, *Saturated soils, *Phosphates, *Louisiana, Ionization, Soils, Ion exchange, Soil-water-plant relationships, Inorganic compounds, Testing, Methodology, Test procedures, Soil analysis, Water quality, Soil water, Soil types, Acidic soils, Akaline soils, Soil properties, Fertilizers, Crops,

Identifiers: Waterlogged soils.

The distribution of various forms of soil phosphate in each of 16 soil types both before and after two months of waterlogging was studied. The more acid soils had a larger fraction of their inorganic phosphate in the forms of aluminum phosphate and iron phosphate while calcium phosphate was highest in the less acid soils. Aluminum phosphate increased as a result of waterlogging in most of the soils. In the finer textured soils, however, aluminum phosphate generally decreased as a result of waterlogging. As an average for all soils, there was an approximate 35% increase in aluminum phosphate due to waterlogging. Iron phosphate also increased as a result of waterlogging in all soils except the Commerce. The average increase was 64%. Part of the increase in iron phosphate was apparently at the expense of reductant soluble iron phosphate although, in the Commerce and two other recent alluvial soils, part of the increase in iron phosphate apparently came from calcium phosphate. (Woodard-USGS) W71-06512

MOVEMENT OF 2.4-D IN SOILS,

New Mexico Agricultural Experiment Station, University Park

H. E. Dregne, S. Gomez, and W. Harris.

New Mexico Agricultural Experiment Station Western Regional Research Project Progress Report, November 1969. 35 p, 21 fig, 8 tab, 41 ref.

Descriptors: *Water pollution sources, *Herbi-Descriptors: *Water pollution sources, *Herbicides, *New Mexico, *Soil water movement, Groundwater, Surface waters, Testing, Test procedures, Methodology, Water quality, Soils, Pesticides, Chromatography, Adsorption, Chemical analysis, Analytical techniques, Bioassay, Soil structure, Infiltration, Soil properties, Leaching, Path of pollutants.

Movement of 2,4-dichlorophenoxyacetic acid (2,4-D) in three soils was studied to determine the extent to which herbicides applied in the field enter the surface and groundwater systems. Analytical techniques used included gas chromatography, thin layer chromatography, soil thin layer chromatography, resin thin layer chromatography, bioassays, and autoradiography. Primary emphasis was placed upon the effect of exchangeable cations on 2,4-D movement. Adsorption isotherms, breakthrough curves, leaching studies, and bioassays indicate that 2,4-D in the acid or salt form, is only slightly adsorbed by soil particles. It is easily leached if the soils are permeable. Virtually 100% of applied 2,4-D was recovered from a sandy loam in six and one-half hours of leaching. Only 38% was recovered from a slowly permeable silty clay loam over a period of ten months. Degradation products of 2,4-D were leached as easily as 2,4-D itself. (Woodard-USGS) W71-06514

Group 5B—Sources of Pollution

THE PATUXENT RIVER, REPORT NO 4, PHYSICAL, CHEMICAL AND BACTERIOLOG-ICAL WATER QUALITY - SUMMER SURVEYS, 1964-1966.

Maryland Dept. of Water Resources, Baltimore. Div. of Water Quality Investigations.

James T. Allison.

Maryland Division of Water Quality Investigations Report, 1968. 70 p, 11 fig, 6 tab, 9 ref, 5 append.

Descriptors: *Water pollution sources, *Rivers, *Water quality, *Maryland, Industrial wastes, Domestic wastes, Data collections, Land use, Chemical analysis, Methodology, Streamflow, Discharge measurement, Runoff, Coliforms, Dissolved oxygen, Biochemical oxygen demand, Water temperature, Precipitation (Atmospheric), Dissolved solids, Turbidity, Color, Acidity. Identifiers: *Patuxent River (Md).

Water-quality data obtained during the three summer surveys of 1964, 1965, and 1966 on a 21mile stretch of the Patuxent River in Maryland are presented. Sampling stations were located between Rocky Gorge Reservoir and the John Hanson Highway (U.S. 50 and 301) crossing of the Patuxent River. Samples were examined regularly for 10 chemical, physical and bacteriological qualities of water which reflect the condition and capacity of the river to assimilate any wastes it receives. Flow measurements were made daily at three sampling stations. Emphasis is placed on dissolved oxygen (D.O.), biochemical oxygen demand (B.O.D.), coliform bacteria, and stream flow as the critical factors in the assessment of water quality. In 1966 serious degradation of water quality with respect to D.O. was noted throughout the lower 15 miles of the study area with maximum stress in the lower reaches where D.O. as low as 1.0 ppm was recorded. Stream flow, which is the greatest single factor controlling the overall waste-assimilative capacity of surface water, decreased from year to year. (Woodard-USGS) W71-06516

WATER QUALITY MONITORING FIELD STUDIES

For primary bibliographic entry see Field 05A. W71-06569

FECAL COLIFORM CONCENTRATIONS IN STORMWATERS,

Robert A. Buckingham, and Roger P. Betson.
Paper presented at the Amer Geophys Union,
Fifty-first Annual Meeting, 1970.

Descriptors: *Storm runoff, *Coliforms, *Overland flow, *Water quality, *Water pollution sources, *Testing.

Identifiers: *Fecal coliforms, *Tennessee Valley.

Recent limited stormwater bacteriological waterquality sampling in the Tennessee Valley indicates that high fecal coliform loads are common in stormwater runoff. In clean residential areas sustained high fecal coliform loads were observed during stormwater runoff. The source of these loads was associated with overland flow, and it appears that staggered contributing times account for the sustained high loads. High fecal coliform counts were also measured in stormwaters originating from agricultural areas and forested watersheds. The consistency with which fecal coliform counts in excess of accepted standards are commonly found further substantiates the need for a reappraisal of this test as an indicator of pathogenic organisms. These data also point to the importance of recognizing the streamflow regime in the analysis of water-quality sampling data since observations taken during storm periods usually in high bacteriological loads.
W71-06570

SEASONAL VARIATIONS IN SURVIVAL OF INDICATOR BACTERIA IN SOIL AND THEIR

CONTRIBUTION TO STORMWATER POLLU-

TION, D. J. Van Donsel, E. E. Geldreich, and N. A. Clarke.

Appl Microbiol, Vol 15, No 6, p 1362-1370, 1967.

Descriptors: Streptococcus, E. coli, Bioindicators. Identifiers: Seasonal survival study.

A three-year study was made on the survival of selected strains of Escherichia coli and Streptococus faecalis in shaded and exposed out-door soil plots. The soils were dosed periodically, and subsequent reductions in survival are shown graphically as seasons variate. Periods for 90-per cent reduction of Esch. coli ranged from 3.3 days in summer to 13.4 days in autumn and for S. faecalis from 2.7 days in summer to 20.1 in winter. During the fall, the survival periods for the organisms were the same, but in spring and winter Streptococcus survived longer. Both organisms could be isolated from runoff during period of heavy rainfall in spring; however, isolation during summer and autumn months was sporadic. On account of these results and other factors, it was considered that Esch. coli was the better indicator of pollution.

THE BACTERIOLOGICAL ASPECTS OF STORM-WATER POLLUTION,

E. E. Geldreich, L. C. Best, B. A. Kenner, and D. J. Van Donsel.

Journal Water Pollution Control Federation, Vol 40, No 11, p 1861-1872, Nov 1968.

Descriptors: *Water pollution sources, *Pollutant identification, Remedies. Identifiers: *Fecal coliforms.

The bacteriological composition of stormwater from a variety of areas was compared and seasonal differences noted. Higher numbers of organisms appear to persist during winter than during summer. The fecal coliform segment of the total coliform population for all stormwater samples averaged 8.6 percent; however, 21.1 percent fecal coliforms were observed in stormwater taken in autumn from a suburban business district. Evidence indicates that fecal contamination in separate stormwater systems originates from cat and dog deposits on soil and from rodent deposits in urban areas. Thus, regulations to prohibit pets on public beaches and improved garbage control plans to discourage rodent proliferation are recommended. Also, diversion of storm drains and land drainage away from beaches and reservoirs would aid in reducing bacterial contamination. W71-06572

ON SIGNIFICANCE OF PSEUDOMONAS AERUGINOSA IN SURFACE WATERS,

A. W. Hoadly.

Journal of the New Eng Water Works Association, Vol 82, No 2, p 99-111, Jun 1968.

Descriptors: *Pseudomonas, *Drainage, Indicators

Identifiers: *Pseudomonas aeruginosa.

Although sewage discharges represent major potential sources of P. aeruginosa in the environment, storm drainage from municipal areas contributes continuous inoculum to surface waters. Farm drainage also can contain small numbers of bacteria under certain conditions. Relatively heavy populations of P. aeruginosa in streams below sewage outfalls decrease rapidly as they progress downstream. The usefulness of this organism as an indicator of the possible presence of enteric pathogens is therefore limited.

THE OCCURRENCE AND BEHAVIOR OF PSEUDOMONAS AERUGINOSA IN SURFACE WATERS, A. W. Hoadley.

Thesis, University of Wisconsin, 1967, Diss Abstr, Vol 28B, p 459-460, 1967, 224 p.

Descriptors: *Pseudomonas, *Indicators, *Storm runoff, *Water pollution sources, *Surface waters, Drainage, Sewage. Identifiers: *Pseudomonas aeruginosa.

Studies on the ecology of Pseudomonas aeruginosa in surface and tap waters and on its usefulness as an indicator of pollution showed that Pseudomonas probably does not occur in waters unaffected by the activities of man and domestic animals. Although farm drainage and storm runoff from urban areas contribute small numbers of Pseuurban areas contribute small numbers of Pseudomonas, sewage discharges probably represent the major source of these organisms entering streams, particularly discharges of crude sewage which may contain up to 700,000 organisms per 100 ml. Although secondary sewage treatment reduces the number of Pseudonomas in domestic sewage by about 99 per cent, growth of the organism has been observed during treatment of slaughterhouse waste waters. Populations of less than 100 per 100 ml occurred in surface waters near areas of human activity but not directly receiving sewage discharges; however, populations of about 100 per 100 ml were detected in public bathing waters in the Madison Lakes, Wis., and very much greater populations were observed in waters recently contaminated with sewage. Although some sterile natural waters supported growth of Pseudonomas in the laboratory, popula-tions of viable Pseudonomas were reduced rapidly in natural surface waters, with reductions of more than 90 percent in three hours. It is concluded that Pseudonomas aeruginosa is a sensitive indicator of pollution of surface waters by sewage and by runoff from urban areas and farmyards. W71-06574

ASSESSING THE QUALITY OF URBAN DRAINAGE,

Warren Viessman, Jr.

Public Works, Vol 100, No 10, p 89-92, Oct 1969.

Descriptors: *Urbanization, *Runoff, *Water quality, Storm runoff, Pollutant identification. Identifiers: *Sediment.

Recommendations are made for further study in the area of identifying sources and constituents of urban runoff through the development and testing of urban water quality models and through the national collection of urban water quality data. Possible sources of pollutants and constituents of stormwater runoff are described with emphasis on a primary pollutant, sediment. Approaches to the development of water quality models are discussed. W71-06575

WATER POLLUTION -- COAST TO COAST. For primary bibliographic entry see Field 05G. W71-06633

URBAN RUNOFF ADDS TO WATER POLLUTION.

Environ Sci Technol, Vol 3, No 6, p 527, Jun 1969.

Descriptors: *Runoff, *Data collections, *Cost analysis, *Surveys, *Separation techniques, Rainfall, Overflow, Biochemical oxygen demand. Identifiers: *Urban runoff, *Chicago, Combined sewers

An APWA survey indicated that: (1) urban runoff constitutes approximately 1% of the raw sewage load which amounts to 5% of the BOD discharged from the area's secondary waste treatment facilities; (2) water pollution from this urban source occurs creating a shock pollution load on receiving waters; (3) the most determinable measure of pollution potential of street litter is the BOD load of the soluble dust and dirt fraction; (4) an estimated expenditure of \$48 billion would be needed to

separate sanitary and storm waters; and, (5) \$15 billion would be needed for alternate control methods for abatement of combined sewer over-

W71-06634

STATUS AND PROPOSED CONTROL OF POL-LUTION IN BOSTON HARBOR AND ITS TRIBUTERIES,

For primary bibliographic entry see Field 05G. W71-06649

WATER QUALITY AT PATUXENT RIVER BRIDGE, MARYLAND - JANUARY 1968 THROUGH NOVEMBER 1969,

Geological Survey, Arlington, Va.
For primary bibliographic entry see Field 05A. W71-06664

RADIOCHEMICAL ANALYSES OF WATER FROM WELLS, SPRINGS, AND STREAMS IN CENTRAL NEVADA,

Geological Survey, Denver, Colo. L. J. Schroder, W. A. Beetem, and Edward Villasana.

Available from the National Technical Information Service as USGS-474-97, \$3.00 paper copy; microfiche \$0.95. Geological Survey Report USGS-474-97, 1971. 24 p, 1 fig, 1 plate, 2 tab, 1 ref. USAEC Agreement No. AT (29-2)-474.

Descriptors: *Path of pollutants, *Fallout, *Nuclear explosions, *Groundwater, *Nevada, Radioactive wastes, Water pollution sources, Data collections, Hydrologic data, Tritium, Radioactivity, Radioisotopes, Sampling, Monitoring. Identifiers: *Groundwater radioactivity.

This report presents the radiochemical data from the central Nevada study area obtained for and analyzed by the U.S. Geological Survey between May 1967 and June 1970. The study area from which samples are reported is in Eureka, Lander, Nye, and White Pine Counties, Nevada. The results of tritium analyses, gross alpha and gross beta analyses are tabulated. (Knapp-USGS)

THE QUANTITY AND QUALITY OF SEDI-MENTS DEPOSITED IN CLEVELAND HARBOR AT CLEVELAND, OHIO,

Corps of Engineers, Chicago, Ill. For primary bibliographic entry see Field 02J. W71-06679

THE ROLE SEDIMENTS PLAY IN DETERMINING THE QUALITY OF WATER,
Corps of Engineers, Omaha, Nebr. Hydro-Sedi-

ment Section.

For primary bibliographic entry see Field 02J. W71-06680

RADIOACTIVE CESIUM IN ESTUARIES,

Naval Ordnance Lab., Silver Spring, Md. Nuclear Physics Div.

Gordon K. Riel

Radiological Health Data and Reports, Vol 11, No 12, p 659-665, December 1970. 7 p, 2 fig, 8 tab, 7

Descriptors: *Fallout, *Cesium, *Estuaries, Path of pollutants, Water pollution sources, Radioisotopes, Mass transfer, Water pollution control, Sediment transport, Tracers, Tracking techniques.

*Chesapeake Bay, Identifiers: radioisotopes.

The concentration of dissolved cesium-137 from fallout in the Chesapeake Bay is on the order of 0.3 pCi/liter, while the concentration is less than 0.1 pCi/liter in the rivers and ocean that supply the Bay's water. The ratio of radiocesium concentration to salinity in the Bay is fairly independent of location and season. Brief studies elsewhere indicate that this pattern is typical of estuaries. (Knapp-W71-06702

FISHERY MANAGEMENT PROGRAM, EX-PANDED PROJECT FOR AQUATIC PLANT CONTROL-FIELD TEST AREAS - FINAL RE-PORT.

Bureau of Sport Fisheries and Wildlife, Atlanta.

For primary bibliographic entry see Field 05C.
W71-06703

SYMPOSIUM ON SEA-LEVEL CANAL BIOEN-VIRONMENTAL STUDIES.

Battelle Memorial Inst., Columbus, Ohio.

Available as BMI-171-28 from NTIS, Springfield, Va 22151, \$3.00 printed copy, \$0.95 microfiche. Martin, William E., Editor. Proceedings of the 19th Annual Meeting of American Institute of Biological Sciences, September 4-5, 1968, Ohio State University, Columbus: Battelle Memorial Institute, Columbus Laboratories, April 21, 1969. 196 p. USAEC Contract No AT (26-1)-171.

Descriptors: *Panama Canal, *Nuclear engineering, *Nuclear explosions, *Excavation, *Canals, Water pollution sources, Ecology, Fallout, Radioactivity, Public health.
Identifiers: *Panama, *Nuclear excavation.

Bioenvironmental studies were made to help judge the radiological-safety feasibility of nuclear-ex-cavation plans for the construction of a sea-level canal across the isthmian region of Central America. As part of the program to predict potential external and internal radiation doses to human populations living in the vicinity of the proposed sealevel canal routes, extensive field studies of human, agricultural, terrestrial, freshwater, and marine ecology were made in eastern Panama and northwestern Colombia. An ecological model shows radionuclide transfer through food chains and other environmental pathways leading to man. The model provides calculations of the kinds and quantities of radionuclides to be expected, during and after nuclear excavation, in the external environments and diets of populations in the two study areas. Estimates of potential radiation doses to man will be based on these calculations. (See also W71-06715 thru W71-06718) (Knapp-USGS) W71-06714

RADIONUCLIDE PRODUCTION FOR THE NUCLEAR EXCAVATION OF AN ISTHMIAN CANAL, Battelle Memorial Inst., Columbus, Ohio.

James R. Vogt.

In: Symposium on Sea-Level Canal Bioenvironmental Studies. Paper 2, April 21, 1969. 6 p, 4 tab.

Descriptors: *Panama Canal, *Nuclear engineering, *Nuclear explosions, *Excavation, *Canals, Water pollution sources, Ecology, Fallout, Radioactivity, Public health.
Identifiers: *Panama, *Nuclear excavation.

The preliminary concept for the construction of a sea-level canal using nuclear explosives is discussed with reference to the number and sizes of nuclear devices that may be required and the characteristics of these devices. The factors affecting radionuclide production and distribution are described along with some recent nuclear experiments conducted by the U.S. Atomic Energy Commission to provide technical data on cratering mechanisms and special emplacement techniques which could minimize the release of radioactivity to the atmosphere. The quantities of radioactivities which would be released into the cloud and local fallout for major excavation projects, using nuclear technology which can reasonably be expected to be available sometime in the future, are presented for a representative set of radionuclides. (See also W71-06714) (Knapp-USGS) W71-06715

THE RETENTION OF SELECTED RADIONUCLIDES FROM DILUTE SOLUTIONS BY PANAMANIAN CLAYS, Florida Univ., Gainesville. Dept. of Environmental Engineering; and Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.

William A. Goldsmith, W. Emmett Bolch, and J. F.

Gamble.

In: Symposium on Sea-Level Canal Bioenvironmental Studies, Proceedings of the 19th Annual Meeting of American Institute of Biological Sciences, September 4-5, 1968, Ohio State University, Columbus. Battelle Memorial Institute, Columbus Laboratories, Paper 12, April 21, 1969. 6 p. 3 fig. 1 tab.

Descriptors: *Adsorption, *Radioisotopes, *Fallout, *Path of pollutants, *Soil water movement, Clays, Clay minerals, Leaching, Ion transport, Panama Canal, Nuclear engineering, Nuclear explosions, Excavation.

Identifiers: *Panama, *Nuclear excavation.

The retention of the radionuclides Ca-45, Sr-89, Cs-137, and Rb-86 was determined for six selected Panamanian clays. The procedure used was that of a slurry test. Gamma emitters were counted by gamma spectroscopy; beta emitters were counted by liquid scintillation. The data have been plotted in a linearized version of the usual uptake or removal curves. The results indicate that all clays used have an ultimate uptake capacity of practi-cally 100% of the applied radionuclides. However, the rate of uptake is markedly different for the various clays. A correlation between the rate of uptake and various clay properties is now being investigated. (See also W71-06714) (Knapp-USGS)

HYDROLOGIC REDISTRIBUTION OF RADIONUCLIDES AROUND A NUCLEAR-EX-CAVATED SEA-LEVEL CANAL,

Isotopes, Inc., Palo Alto, Calif.
R. L. Charnell, T. M. Zorich, and D. E. Holly.
In: Symposium on Sea-Level Canal Bioenvironmental Studies, Proceedings of the 19th Annual Meeting of American Institute of Biological Sciences, September 4-5, 1968, Ohio State Univer-sity, Columbus. Battelle Memorial Institute Columbus Laboratories, Paper 15, April 21, 1969. 12 p, 4

Descriptors: *Panama Canal, *Nuclear engineering, *Nuclear explosions, *Excavation, *Canals, Water pollution sources, Ecology, Fallout, Radioactivity, Public health.
Identifiers: *Panama, *Nuclear excavation.

The hydrologic redistribution of radionuclides deposited in the environment following nuclear excavation of a sea-level canal are discussed. Additionally, a simple comprehensive numerical model is presented by which estimates of the rates of removal of radionuclides from deposited fallout and from the ejecta and fallback can be made. Following a nuclear cratering explosion, a spectrum of rock fragments which contain radioactivity as fis-sion and activation products will surround the ex-cavation area. Dust and fine particles will be deposited further out as wind and base-surge distributed fallout. Following the initial deposition of radionuclides, redistribution will be accomplished primarily by the movement of water. Radioactive products may be moved from the initial point of deposition both as particles containing radioactive isotopes and as dissolved radionuclides leached from rubble and fallout material. Radioactive products may be moved either by surface or groundwater. (See also W71-06714) (Knapp-USGS)

W71-06718

KINETIC MODEL OF FISH TOXICITY THRESHOLD,

California Univ., Berkeley. Dept. of Civil Engineer-

Group 5B-Sources of Pollution

For primary bibliographic entry see Field 05C. W71-06734

INFLUENCE OF PESTICIDE RUN-OFF IN MONTEREY BAY.

Naval Postgraduate School, Monterey, Calif. Dept.

of Oceanography.
For primary bibliographic entry see Field 05C.
W71-06742

TARGET DATES FOR SECONDARY TREAT-MENT AND STORMWATER SEPARATION ON LOWER MISSOURI AND MISSISSIPPI RIVERS, For primary bibliographic entry see Field 05D. W71-06744

A PLAN FOR ENDING LAKE ERIE POLLU-

For primary bibliographic entry see Field 05G. W71-06747

POLILITION OF THE CHAO PHRAYA RIVER. R F Leffel

J Sanit Eng Div, Am Soc Civil Engrs, Vol 94, No SA2, p 295-306, Apr 1968.

Descriptors: *Foreign research, Estuaries, Waste water treatment, Water pollution sources. Identifiers: *Chao Phraya River, Thailand.

Programmed sampling and tests of the Chao Phraya River Estuary show that its pollutionreceiving capacity is limited. No sewage collection system presently exists in Bankgok, but separate waste water and stormwater systems are being planned because a combined system would undoubtedly cause further pollution of the estuary during severe rainfall. More studies must be made before the degree of oxidation of organic carbon, nitrogen, and amoniacal nitrogen can be accurately determined. Further studies are also being conducted to decide upon the necessary type of initial waste water treatment. Such treatment must include sufficient oxidation of organic carbonaceous substances and oxidizable nitrogenous substances. This study also demonstrates the need for modifications in standard BOD measurements in addition to modifications of the parameters and equations defining DO concentrations for tropical estuaries. W71-06748

WATER RESOURCES AS AN ELEMENT OF URBAN PLANNING,

M. L. Rockwell.

J Urban Planning Devel Div, Am Soc Civil Engrs, Vol 94, No UPI, p 1-9, Aug 1968.

Descriptors: *Water utilization, *Storm runoff, Reservoir storage, *Urbanization, Waste water treatment, Water pollution sources.

An examination is made of the complex technical, legal, and administrative problems involved in northeastern Illinois' water situation and the high degree of use and reuse taking place in this area. Even stormwater runoff along with its pollutants is retained in reservoirs to be used later beneficially. Existing problems related to stormwater runoff in this area include the restriction of water infiltration and, thus, the production of increased runoff caused by the construction of impermeable surfaces (roof tops, streets, and parking lots), and the maintenance of unsightly stormwater basins in areas where water recreational facilities are needed. W71-06753

ESTABLISHMENT OF WATER QUALITY STANDARDS IN THE CITY OF TAKAMATSU. For primary bibliographic entry see Field 05G. W71-06767

STANDARDS FOR EFFLUENTS IN SWITZER-LAND.

Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland).
For primary bibliographic entry see Field 05G.

DEAD ANIMALS AND HOW THEY CONTRIBUTE TO POLLUTION OF THE ENVIRON-MENT,

Department of Agriculture, Madison, Wis. For primary bibliographic entry see Field 05G. W71-06815

WATER QUALITY PROBLEMS,

Wisconsin Dept. of Natural Resources, Madison. For primary bibliographic entry see Field 05G. W71-06816

FUTURE TRENDS IN LIVESTOCK PRODUC-

Wisconsin Univ., Madison. Coll. of Agriculture. For primary bibliographic entry see Field 05G. W71-06817

WHAT AND WHERE ARE THE CRITICAL SITUATIONS WITH FARM ANIMAL WASTES AND BY-PRODUCTS IN WISCONSIN, Wisconsin Univ., Madison.

For primary bibliographic entry see Field 05G. W71-06818

A COMPREHENSIVE SURVEY OF INDUSTRIAL WASTE POLLUTION IN SOUTH

CAROLINA,
Texas A and M Univ., College Station. Roy W. Hann, Jr., and F. D. Callcott.
Proceedings, Twentieth Industrial Waste Conference, May 4-6, 1965, Purdue University, Lafayette, Ind, p 538-550, July 1965. 8 fig, 1 tab, 7

Descriptors: *Industrial wastes, Biochemical oxygen demand, *South Carolina, Cotton, Textiles, Waste water treatment.
Identifiers: *Cotton wastes, Slashing wastes, *Wool

scouring, Dyehouse wastes, *Textile mill wastes, Man-made fiber plants, Desizing.

The nature and magnitude of pollutants being discharged into South Carolina rivers by each industrial group, the location of the discharges, and the industrial processes that give rise to such waste discharges are summarized in this paper. In inland streams textiles contribute 10 times the pollutional load of its nearest competitor, the pulp and paper industry. Cotton wastes, presenting the major pollution problem, come from fiber preparation, bleaching, and finishing. Some wastes are directly toxic to aquatic life; high biochemical oxygen demand is indirectly toxic. Only 10% of the grey goods manufacturers in South Carolina treat their wastes in any way, and few finishing plants separate wastes for treatment. their process processing wastes come primarily from the scouring chain. Those synthetic fibers made of natural substances cause more pollution than do nylon, orlon, or fiberglass - non-natural fibers. (Sheffield-North Carolina State University) W71-06927

THERMAL EFFECTS AND NUCLEAR POWER STATIONS IN THE USA,

Argonne National Lab., Ill. Argonie Padicional Eady, Inc.

D. Miller, J. V. Tokar, and R. E. Nakatani.

Available from NTIS as CONF-700810-30, \$3.00 in paper copy, \$0.95 in microfiche. Conference paper CONF-700810-30 (IAEA-SM-146/30), paper CC 1970. 14 p.

Descriptors: *Nuclear power plants, *Water temperature, *Ecosystems, *Cooling water, Heated Identifiers: *Steam power plants.

Steam-electric stations discharging heated condenser cooling water into public waters will modify the aquatic environment. There is no question that some changes will occur, but the biological problem is to determine the degree of changes, both short-term and long-term, the extent of these changes, and to determine if they significantly affect water uses. Pressing biological problems are identified and needed research and development are recommended. Examples of problems considered are as follows: (1) Compliance with water temperature standards. (2) Lack of definition of mixing zones. (3) Lack of approved state water temperature standards. (4) Predicting temperature distributions in receiving water. (5) Assessment of biological changes. (6) Design of intake and outfall structures to minimize biological damage -- fish protection facilities. (7) Nuisance growth of plants and algae. (8) Sublethal effects of temperature on w71-06932

MOLECULAR PHYSICS OF THE SEA, PART

Naval Research Lab., Washington, D.C. V. V. Shuleikin.

Available from NTIS as AD-711 952, \$3.00 in Available from N11s as AD-/11 932, \$3.00 in paper copy, \$0.95 in microfiche. NRL Translation No 797, 1960. 40 p. Excerpt from the book (p 786-819) entitled: Fizika Morya, Part VIII, beginning with Section No 10, Surface Active Films on the Sea, 3rd edition, Izdatel'stva Akademii Nauk, SSSR, 1953, Moscow. 989 p. Identifiers: *Oceans, *Films, *Oils, *Water pollu-

tion, *Surface-active substances, Oceans, *Water waves (Damping), Surface properties, Drift, Ocean waves, Absorption, Test methods, Surface tension, Salinity, USSR, *Oil pollution, Translations.

The report discusses the damping of ocean waves by films. The films discussed are both from oil or surface active substances. Also the surface tension of these films was studied in relation to the ocean's salinity. W71-06938

DON'T POLLUTE A CLEAN RESERVOIR. Oil and Gas Journal, Tulza, Okla.

Oil and Gas Journal, November 16, 1964, (Reprint). 2 p, 2 tab.

Descriptors: *Bacteria, *Water wells, Drilling, Sulfate-reducing bacteria, Iron bacteria, Drilling fluid, Corrosion, *Oil industry, Surfactants, Detergents, *Bactericides.

genia, Bacteriales.

Identifiers: *Microbiological contamination, Cement filtrate, Hydraulic fracturing fluid, Cationic quaternary, Alkylbensyl-trimethyl ammonium quaternary, Alkylber chloride, Clay swelling.

Bacterial contamination of a producing well from drilling mud or fracture fluid has been overlooked for many years in spite of our knowledge of bacteria in connection with waterflooding operations. But the problem has finally been recognized, and remedial action can be taken, if the right chemicals are used. Producing formations in wells drilled for the production of oil, gas, or water, are all subject to contamination because of contact with drilling fluid, cement filtrate, and hydraulic fracturing fluid. Most trouble in contamination cases can be traced to one or two sources - sulfate-reducing bacteria, or iron bacteria. Both of these are capable of reducing permeability of a producing formation through deposition of their by-products, or through their presence in extremely large numbers. Having recognized the problem, the next step was to find a chemical that would solve it. After testing many chemicals, it was found that a cationic quaternary, alkylbenzyl trimethyl ammonium chloride, was most effective. It is a bactericide. It behaves as a corrosion inhibitor because of its film-forming properties. Its detergent properties aid in preventing clay swelling, and it is a nonemulsifier. (Campbell-NWWA) W71-06943

Effects of Pollution—Group 5C

LABORATORY STUDY OF THE BEHAVIOR OF A SANITARY LANDFILL,

Drexel Univ., Philadelphia, Pa A. A. Fungaroli, and R. L. Steiner.

Journal Water Pollution Control Federation, Vol 43, No 2, p 252-267, February 1971. 16 p, 20 fig, 3 tab, 12 ref. USPHS Grant No 5-R01-UI00516.

Descriptors: *Landfills, *Hydraulic models, *Lysimeters, *Leaching, *Water pollution sources, Garbage dumps, Sanitary engineering, Infiltration, Soil water movement, Path of pollutants. Identifiers: Sanitary landfills.

The design and operation of a simulated sanitary landfill is described. The behavior of the model, a lysimeter, is best described as an aerobic state, followed by an anaerobic state. Sustained high pollution levels were measured in the leachate, with COD levels at approximately 20,000 mg/liter. (K-napp-USGS) W71-07011

LIGNOSULPHONATES IN LAKE PALIANNE WATER.

Helsinki City Waterworks (Finland). Construction Dept.

Seppo Priha.

ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 97, No SA2, Paper 8021, p 191-207, April 1971. 17 p, 6 fig, 2 tab, 12 ref.

Descriptors: *Water pollution sources, *Lakes, *Pulp wastes, *Sulfite liquors, Water treatment, Water quality, Water pollution, Water supply, Industrial wastes, Wood wastes, Organic wastes, Sulfonates.

Identifiers: Lake Paijanne (Finland), Finland.

The water requirements of the city of Helsinki and its adjacent urban areas can be satisfied from the present sources up to about 1978. In order to meet present sources up to about 1978. In order to meet the demand from the 1980's on, water will be conveyed to Helsinki in a 120-km long rock tunnel from the southern end of Lake Paijanne, the central lake of the Kymi River basin. The total volume of the lake is approximately 17.3 billion cu m as measured from mean water level. Industrial and domestic waste waters are released into the lake and water courses empty into it. These wastes are mostly made up of the effluents of pulp mills and the spent liquor from the cooking processes. The lignosulphonic acids in these wastes have spread more or less over the whole lake and form an immore or less over the whole lake and form an important factor in judging its water quality and suitability as a supply for drinking water purification. The Water Examination Bureau at the Helsinki City Waterworks has carried out water quality studies on the lake since 1965. These studies include measuring lignosulphonate content at sampling standard southern parts of the lake standard so tions in central and southern parts of the lake and parallel pilot plant treatment runs with Lake Paijanne water and water from the present raw water supply. (Knapp-USGS)
W71-07027

THE INFLUENCE OF DECOMPOSING SAL-MON ON WATER CHEMISTRY, Alaska Univ., College. Inst. of Water Resources. John J. Goering, and David C. Brickell.

Available from National Technical Information Service as PB-198 431, \$3.00 in paper copy, \$0.95 in microfiche. Alaska Institute of Water Resources. College, Report No. IWR-12, 1971. 27 p, 7 fig, 3 tab, 8 ref. OWRR Project B-014-ALAS (1).

Descriptors: *Salmon, Estuarine environment, Nutrients, Alaska, *Decomposing organic matter, Organic wastes, Industrial wastes, Water pollution sources, Ammonification, Nitrification. Identifiers: Iliuliuk Bay (Alas).

The chemical dynamics of sea food waste decomposition and of salmon decomposition in a marine system were studied. A drastic increase in NH4 (..)-N and decrease in 02 occurred in the marine bay (Iliuliuk Bay, Unalaska Island, Alaska) receiving sea food processing wastes. A seaward decreasing

but elevated NH4 (..)-N suggests that this bay influences the nitrogen economy of the adjacent ocean. Salmon carcasses decomposition was followed in a spawning stream and its associated estuary (Little Port Walter, Alaska). Concentrations of NH4 (..)-N and organic -N in the water were determined in this system weekly, beginning before spawning and ending several months later. NH4 (..)-N and dissolved organic -N in the stream and estuary were low and unvariable before spawning. During spawning, NH4 (..)-N and organic -N increased downstream. As carcasses increased the NH4 (..)-N and organic-N became greater. Large increases of organic -N in the stream and estuary also resulted from salmon decomposi-W71-07057

5C. Effects of Pollution

MONITORING ECOLOGICAL CONDITIONS ASSOCIATED WITH WIDE-SCALE APPLICATIONS OF DMA 2,4-D TO AQUATIC ENVIRON-MENTS.

Tennessee Valley Authority, Muscle Shoals, Ala. Div. of Environmental Research.

For primary bibliographic entry see Field 05B. W71-06462

AN OIL DISPERSANT'S EFFECT ON THE MICROFLORA OF BEACH SAND,

Washington Univ., Seattle, Wash. Dept. of Zoolo-

gy. Stephen A. Bloom. Journal Marine Biology Association of the United Kingdom, Vol 50, No 4, p 919-923, 1970. 5 p, 2 fig, 5 ref. NIH Grant.

Descriptors: *Oily water, *Water pollution control, *Water pollution treatment, *Detergents, Biodegradation, Water pollution effects, Beaches,

Identifiers: *Oil spills, *Oil-spill cleanup, Corexit

The effects of 'Corexit 7664', an oil dispersant, alone and in combination with oil in sand columns were determined by oxygen uptake, C-14 uptake, and chlorophyll analysis. 'Corexit' had no obvious deleterious effects within the experimental system under the conditions of periodic and continuous additions ranging from 500 ppm to 100,000 ppm and in combination with Kuwait crude oil. No change was observed in chlorophyll or C-14 uptake. Heightened oxygen uptake was noted for continuous addition of 'Corexit', for the oil control, and for oil plus 'Corexit'. Caloric content of the oil and oxygen uptake indicated an extended degradation period. (Knapp-USGS) W71-06491

THE DECOMPOSITION OF CRUDE OIL RESIDUES IN SAND COLUMNS, Marine Lab., Aberdeen (Scotland)

For primary bibliographic entry see Field 05B. W71-06492

ON THE STAGNATION AND RECENT TURNOVER OF THE WATER IN THE BALTIC,

Fishery Board of Sweden, Goteborg. Hydrographic Department.

Stig H. Fonselius.

Tellus, Vol 22, No 5, p 533-544, 1970. 12 p, 13 fig,

Descriptors: *Eutrophication, *Salinity, *Density stratification, *Water circulation, *Water balance, Hydrologic budget, Nutrients, Turnovers, Water pollution effects, Path of pollutants. Identifiers: *Baltic Sea.

The hydrography and water balance of the Baltic are described. Nutrients accumulate through runoff and decay of organic matter in the deep stag-

nant water, supplying the surface with organic matter, ammonia, nitrogen, and hydrogen sulphide. Oxygen has decreased in the Baltic deep water during the present century. An increased primary production in the surface water is predicted and a prognosis for the future development of the oxygen conditions in the Baltic is given. It is concluded that Man has increased the oxygen utilization in the deep water by the enormously increased discharge deep water by the enormously increased discharge of untreated waste water from industries and communities and that the Baltic therefore has been 'overstrained.' Measures against future waste discharge must be taken to give the Baltic a chance to recover. (Knapp-USGS) W71-06498

THE EFFECTS OF THERMAL LOADING AND WATER QUALITY ON ESTUARINE PRIMARY PRODUCTION,

Maryland Univ., Solomons. Natural Resources Inst.

Maryland Univ., Solomons. Natural Resources Inst. David A. Flemer, D. Heyward Hamilton, Carolyn W. Keefe, and Joseph A. Mihursky.

Available from NTIS as PB-198 304, \$3.00 in paper copy, \$0.95 in microfiche. Natural Resources Institute Reference No 71-6, December 1970. 217 p, 67 fig, 54 tab, 277 ref. OWRR Project C-1401 (No 1979) (2).

Descriptors: *Water quality, *Thermal pollution, *Estuarine, *Phytoplankton, *Primary productivity, *Copepods, Maryland, Environment, Marine bacteria, Secondary productivity, Cycling nutrients, Photosynthesis, Eutrophication, Carbon nutrients, Photosynthesis, Eutrophication, Carbon cycle, Carbonates, Carbohydrate, Chlorophyll, Seston, Organic matter, Proteins, Carbon, Nitrogen, Nitrogen cycle, Nitrates, Nitrites, Ammonia, Phosphates, Phosphorus compounds, Dissolved oxygen, Salinity, Light penetration, Turbidity, Marshes, Freshwater marshes, Tidal marshes, Salt marshes, Rooted aquatic plants, Wild rice, Plant growth substances, Heated water, Thermal

power plants, Electric power. Identifiers: *Chesapeake Bay, *Patuxent River, Acetone, Cattail, Spartina, Indoleacetic acid.

Data on the hydrography, nutrient chemistry, primary production, standing crops of phytoplankton and zooplankton, and the effects of entrainment on the phytoplankton-bacteria community by a power plant in the upper Patuxent estuary are reported for the period August 1968 to August 1970. Carbonthe period August 1700 to ranges. 1710 to 14 uptake by the plankton under constant light ranged from 0.1 to 598 mg/cu m hr. Chlorophyll a values ranged from 0.1 to 120 mg/cu m. Maximum chlorophyll a and productivity values were measured in the oligohaline reaches where the salinity gradient was strongest. Locations above and below this region exhibited lower values. Calculated primary production ranged from 0.01 to 5.77 g/sq cm day and the spacial pattern was inversely related to turbidity and the volumetric measurements of productivity. Maximum penetration of high nutrient levels into the estuary occurred during the winter. Nutrient concentrations were high and comparisons with earlier published data indicate accelerated rates of nutrient input. Published information on intake-effluent studies showed that the power plant can cause a significant reduction in the standing crop and photosynthetic rates of entrained organisms. The effects of chlorination on entrained organisms may be more important than those of heat. We did not observe measurable effects of entrainment in the open river near the power plant. Preliminary studies were made on the species composition, chemical content, biomass and production of marsh vegetation. The total production of all the marshes in the study area was estimated at 23.3×2 million 330 thousand kg dry matter year of which 23,100 kg was nitrogen and 3900 kg was phosphorus. The study extended biomass data on some important zooplankton species, e.g., Eurytemora affinis. W71-06595

ENVIRONMENTAL IMPACT OF POWER PLANTS.

Corps of Engineers, Fort Belvoir, Va. Operations

Group 5C—Effects of Pollution

Robert E. Donovan. The Military Engineer, Vol 63, No 411, p 5-8, January-February 1971. 4 p, 4 fig, 1 tab.

Descriptors: *Nuclear power plants, *Environmental effects, *Water pollution sources, *Pollutant identification, *Electric powerplants, Thermal pollution, Air pollution, Radioactivity effects, Environment, Oxides, Reviews, Fish, Aquatic life, Thermal powerplants.

Identifiers: *Conventional powerplants.

Along with the need for added electrical power comes an increase in the potential for environmental pollution. Environmental effects in the immediate vicinity of the plant during normal opera-tion are considered in this report. Gneralizations tion are considered in this report. Gneralizations are made concerning the relative adverse ecological effects of nuclear and conventional power plants. Conventional plants cause less radioactive pollution, but radioactive releases are under strict control and their effect on the environment appears to be minimal. Conventional plants have a decided short term advantage in the results. decided short-term advantage in thermal pollution. In those applications where thermal pollution of cold-water fisheries is critical, conventional plants have the advantage regardless of whether or not cooling towers and basins are used. This advantage probably will be largely eliminated in 5 to 10 years. (Woodard-USGS) W71-06663

FISHERY MANAGEMENT PROGRAM, EX-PANDED PROJECT FOR AQUATIC PLANT CONTROL-FIELD TEST AREAS - FINAL RE-

Bureau of Sport Fisheries and Wildlife, Atlanta, Ga. Div. of Fishery Services.

Bureau of Sport Fisheries and Wildlife Report, October 17, 1969. 88 p, 4 fig, 42 tab, 10 ref, append.

Descriptors: *Water pollution sources, *Herbicides, *North Carolina, *Louisiana, Surface waters, Toxicity, Testing, Methodology, Test procedures, Evaluation, Alligatorweed, Chemical analysis, Data collections.
Identifiers: *Herbicides (Silvex).

The effects of the herbicide Kuron (silvex) applications to alligatorweed on water quality and fish in surface waters of North Carolina and Louisiana are presented. Three treatments of Kuron (silvex) were applied at a rate of eight pounds acid equivalent per surface acre to alligatorweed at two study areas in North Carolina. Field observations indicated that silvex at the concentration applicable in treating alligatorweed was toxic to certain species of fish at one of the study areas. Laboratory analysis showed accumulations as high as 70 ppm in nonpredator fish flesh. Invertebrates contained silvex residues in varying concentrations for more than seven weeks. Water and hydrosoil samples in most cases contained silvex residues for seven months after the last treatment. Three ponds in Louisiana collectively received a total of 13 Kuron treatments using the same application rate as used in North third the same application rate as used in votting Carolina. Fish mortality occurred in seven of the thirteen treatments. Mortality was observed at all three ponds during the study. Laboratory analysis showed silvex accumulations as high as 19 ppm in non-predator fish and 16 ppm in predator fish. Silvex treatments changed the invertebrate composition. Water and hydrosoil contained silvex residues in varying concentrations. (Woodard-USGS) W71-06703

SYMPOSIUM ON SEA-LEVEL CANAL BIOEN-VIRONMENTAL STUDIES.

Battelle Memorial Inst., Columbus, Ohio. For primary bibliographic entry see Field 05B. W71-06714

ELEMENTAL AND HYDROLOGIC BUDGETS OF THE PANAMANIAN TROPICAL MOIST

FOREST, Georgia Univ., Athens. Inst. of Ecology For primary bibliographic entry see Field 02A. W71-06717

A LABORATORY METHOD FOR THE STUDY OF MARINE BENTHIC DIATOMS, OF MAKINE BENTHIC DIATIONS,
Oregon State Univ., Corvallis. Dept. of Botany.
C. David McIntire, and Barry L. Wulff.
Limnology and Oceanography, Vol 14, No 5, p
667-678, 1969. 6 fig. 4 tab, 20 ref. NSF Grant GB-

Descriptors: *Laboratory tests, *Laboratory equipment, *Benthic flora, *Light intensity, *Ecosystems, *Model studies, Diatoms, Vertical migration, Distribution patterns, Respiration, Inter-

itidal areas, Acclimatization, Bottom sediments, Tidal effects, Oregon.
Identifiers: *Marine benthic diatoms, *Yaquina Bay (Oregon), *Model ecosystem, Desiccation, Vertical distribution, Substrate, Respirometer.

Effects of light intensity and of exposure to desiccation on the vertical distribution and growth of populations of marine benthic diatoms were investigated in a laboratory model ecosystem and in a respirometer chamber. The diatom flora that developed in the ecosystem was similar to that from field stations in lower Yaquina Bay, Oregon. The vertical distribution of many species was closely related to light intensity and period of exposure to desiccation. Biomass accumulated most rapidly on substrates subjected to high light intensities, without exposure to desiccation. Communities acclimated to different light intensities and periods of climated to different light intensities and periods of desiccation responded differently to changes in light intensity in the respirometer chamber. Results of these experiments indicate that the laboratory apparatus described can be useful in the study of simplified intertidal communities. (Sjolseth-Washington) W71-06723

FIELD OBSERVATIONS ON THE USE OF SODIUM CYANIDE IN STREAM SURVEYS, Tennessee Game and Fish Commission.

William R. Tatum.

Presented at the 22nd Annual Meeting of the Southern Division of the American Fisheries Society, Baltimore, Oct 21-23, 1968. Unpublished. 7 p manuscript only. 1 tab, 3 ref.

Descriptors: *Fish populations, *Toxicity, *Evaluation, *Census, Tennessee, Surveys, On-site investigations, Sodium compounds, Fish management, On-site data collections, Crustaceans, Water temperature, Benthos, Benthic fauna, Insects, Mollusks, Annelids, Trout, Rainbow trout. Identifiers: *Sodium cyanide, *Stream surveys.

Sodium cyanide has been an effective method for sampling the stream fish populations in Eastern Tennessee. Its portability makes it a practical stream management tool. Cyanide is an excellent cold weather sampling method. Three ounces of cyanide in trout streams and six ounces in warmwater streams per cubic foot per second flow will sample 100 yards. In water colder than 55F, mor-tality of fish is not acute. Rainbow trout and various warmwater fish collected with cyanide and held in aquaria showed no deleterious effects from exposure to the chemical. Reduction in stream invertebrate populations after cyanide application is evident. (Sjolseth-Washington) W71-06724

CHEMICAL COMPOSITION OF RAINBOW TROUT URINE FOLLOWING ACUTE HYPOX-IC STRESS,

Bureau of Sport Fisheries and Wildlife, La Crosse, Wis. Fish Control Lab.

Joseph B. Hunn.

Transactions of the American Fisheries Society, Vol 98, No 1, p 20-22, 1969. 1 tab, 16 ref.

Descriptors: *Stress, *Oxygen requirements, *Urine, *Rainbow trout, *Fish physiology, Sodium, Potassium, Magnesium, Phosphates, Chlorine, Hydrogen ion concentration, Trout, Salmonids. Identifiers: *Salmo gairdnerii.

Rainbow trout were anesthetized with MS-222, catheterized, and placed in urine collecting cham-bers. After acclimation and collection of control bers. After acclimation and collection of control urine samples, water flow was discontinued for 30 min. Oxygen levels dropped from 4.9 to 2.8 mg/l. Following this stress, water flow was restored an accumulated urine samples were collected at 1, 4 and 20 hours post-stress. Normal urine pH is 7.0, but post-hypoxia it becomes acidic. Abnormally high levels of Na K, Mg, Cl and inorganic PO4 were present in the urine after hypoxic stress. (LeGore-Washington) W71-06725. W71-06725

CONTROL OF OYSTER DRILLS, EUPLEURA CAUDATA AND UROSALPINX CINEREA, WITH THE CHEMICAL POLYSTREAM, Bureau of Commercial Fisheries, Milford, Conn.

Biological Lab.

Clyde L. MacKenzie, Jr. Fishery Bulletin, Vol 68, No 2, p 285-297, 1970. 2 fig, 5 tab, 7 ref.

Descriptors: *Chemcontrol, *Pesticide toxicity, *Gastropods, Oysters, Chemicals, Aquiculture, Chlorinated hydrocarbon pesticides, Organic compounds, Predation, Snails. Identifiers: *Oyster drills, *Polystream, *Polychlorinated benzenes, *Benzene, Control, Eupleura caudata, Urosalpinx cinerea, Chlorinated

benzenes. Depuration.

Oyster drills are important predators on commer-Oyster drills are important predators of Connectial oyster beds. Applications of Polystream (Hooker Chem. Corp., mixture of polychlorinated benzenes) killed up to 100% of the drills when currents were of low velocity. Spring treatment appears more effective than later treatment, although surviving drills cease feeding for several months, and populations remained reduced for at least two years. Small Polystream residues were noted in oyster tissues, but these were soon eliminated by depuration. Gastropods other than drills were also killed and many other invertebrates were affected by treatment, although entire populations were not eliminated. Several fish were killed, but the extent of the deleterious effect is unknown. (LeGore-Washington) W71-06726

LABORATORY EVALUATION OF SOME ORGANOPHOSPHOROUS COMPOUNDS AGAINST THE LARVAE OF AEDES (O.) DETRITUS (HALIDAY), AEDES (O.) CASPIUS (PALLAS) AND CULEX PIPIENS L. Montpellier Univ. (France).

G. Gras, and J. A. Rioux.

Mosquito News, Vol 29, No 2, p 202-209, June, 1969. 5 fig, 6 tab, 15 ref.

Descriptors: *Laboratory tests, *Organophosphorous pesticides, *Mosquitos, *DDT, *Bioassay, *Toxicity, *Larvacides, *Chlorinated hydrocarbon pesticides, *Metal organic pesticides, *Pest control, *Pesticides, Evaluation, Chemcontrol, Larval growth stage, Lethal limit, Insect control, Pesticide toxicity.

Identifiers: *Aedes caspius, *Aedes detritus, *Cu-lex pipiens pipiens, Parathion, Fenthion, Dorsban, Malathion, Fenitrothion.

LC50 and LC90 values for the fourth instar larvae of three species of mosquito are given for 30 insecof three species of mosquito are given for 30 insecticides. Twenty-five are organophosphorous compounds. DDT, carbonyl and three organometallic compounds are included for comparison. Dosage response time and susceptibility level graphs are given for the organophosphorous compounds. (Sjolseth-Washington)
W71-06727

A POTENT CHEMOTHERAPEUTIC AGENT AGAINST FISH DISEASES: 6-HYDROXY-METHYL-2- (2- (5-NITRO-2-FURYL) VINYL) PYRIDINE (P-7138),

Dainippon Pharmaceutical Co., Osaka (Japan). Masanao Shimizu, and Yoshiyuki Takase.

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Effects of Pollution—Group 5C

Bulletin of the Japanese Society of Scientific Fisheries, Vol 33, No 6, p 544-554, 1967. 2 fig, 15 tab, 9

Descriptors: *Pyridine pesticides, *Fish diseases, *Bactericides, *Fish farming, *Fungicides, *Aquiculture, *Inhibition, Fish management, management, Chemcontrol, Pathogenic bacteria, Eels, Analytical techniques, Inhibitors, Toxicity, Evaluation, Absorption, Growth rates, Fungi.

Identifiers: *Chemotherapeutic agents, *P-7138, *Aeromonas liquefaciens, Aeromonas monicida, Saprolegnia parasitica, Goldfish.

6-Hydroxymethyl-2 (2- (5-nitro-2-furyl) vinyl) pyridine (P-7138) exhibited inhibitory activity in vitro at low concentrations (1 mcg (sic)/ml or less) against most of 30 tested Gram negative and Gram positive bacteria, including several strains isolated from fight to work the activity in the strain is olded. from fish. It was also active in vitro against fungi and Trichomonas sp. P-7138 was effective against Aeromonas liquefaciens both when administered orally to fish and when fish were bathed in solution.

Only doses on the order of 2000 mg/kg of fish weight were lethal to eels. (Sjolseth-Washington)

OXYGEN POISONING IN THE ANNELID TU-BIFEX TUBIFEX. I. RESPONSE TO OXYGEN

EXPOSURE,
Illinois Univ., Urbana. Dept. of Physiology. Joann G. Walker.

The Biological Bulletin, Vol 138, No 2, p 235-244, 1970. 2 fig, 3 tab, 31 ref.

Descriptors: *Tubificids, *Water pollution effects, *Mortality, *Dissolved oxygen, Annelids, Respira-tion, Animal physiology, Analytical techniques, Laboratory tests, Acclimatization, Environmental effects, Toxicity, Animal behavior, Pressure, Aquatic animals, Aquatic environment, Gases, Worms, Oxygen, Pathology, Nitrogen.

Identifiers: *Tubifex tubifex, *Oxygen poisoning, *Pressure effects, *Hyperbaric oxygen, Adapta-

Exposure to hyperbaric oxygen caused T. tubifex to become hyperactive. The behavioral response to oxygen pressure became complete only after several hours, when the animals either disintegrated or began to resume normal behavior. Exposure to four atmospheres absolute oxygen pressure for 13-15 hr caused high mortality of T. tubifex. Exposure to four atmospheres of absolute oxygen pressure for 9-12 hr killed approximately half of the treated animals, while exposure for 8 hr or less caused no greater mortality than in unexposed controls. The lethal effects of oxygen exposure developed only after several hours. Exposure to three atmosphere of nitrogen added to one atmosphere of air for as long as 30 hr resulted in no more deaths than in unexposed controls and caused no change in worm behavior. Interruption of a 16 hr oxygen exposure with return to atmospheric conditions enhanced survival of oxygen-treated T tubifex. Increased duration of interruption led to increased survival of oxygen-treated worms. Adaptation to hyperbaric oxygen occurs in T. tubifex fol-lowing several weeks of exposure to atmospheric oxygen tensions in shallow containers without a protective mud environment. (Sjolseth-Washington) W71-06730

THE RELATION BETWEEN TEMPERATURE AND TOXICITY OF PCP FOR THE CARP FISH.
STUDIES ON THE BIOLOGICAL ASSAY OF CHEMICALS TO FISH. VI (IN JAPANESE), Ihara Agricultural Chemicals Inst., Shimizu

(Japan).

Shoji Asano, Sumio, Nagasawa and Shizue Fushimi.

Botyu-Kagaku, Vol 34, No 1, p 13-21, 1969. 7 fig, 6 tab, 17 ref. English summary.

Descriptors: *Phenols, *Carp, *Bioassay, *Toxicity, *Water temperatures, Fish physiology, Thermal stress, Water pollution effects, Lethal limit, Regression analysis, Mathematical studies, Isotherms, Fishkill, Statistical methods, Statistical models, Chemical wastes.
Identifiers: *PCP, *Water temperature effects.

Relationships between the lethal action of PCP-Na (sodium pentachlorophenate) salt to carp and temperature are discussed from statistical and physiological points of view. A complete time-mortality curve is presented. The median lethal times in a PCP concentration of 0.8 ppm were determined at 23, 26, 29, 32 and 35 deg C. A linear relationship between the median lethal time and temperature was obtained, and a positive temperature coeffi-cient for PCP lethality was found. PCP's lethality increases approximately two-fold with each 10 deg increases approximately two-fold with each 10 deg C rise in temperature. The standard deviation of the carp's susceptibility, however, increases with increasing temperature. The median lethal times at PCP concentrations of 0.5 to 16.0 ppm were also determined at 20, 23, 26, 29 and 32 deg C. The relationship between lethal time, PCP concentration and temperature could be determined with a multiple regression equation. By transforming concentration into temperature, with a factor for equalizing individual differences in lethal concentration, the relationship between temperature and lethal time was derived. A linearity similar to that described above was obtained between these two variables. (LeGore-Washington) W71-06731

THE LEVEL OF N-AMMONIA AND N-UREA IN THE BLOOD SERUM AND BRAIN OF HEALTHY AND AMMONIA-INTOXICATED CARPS (CYPRINUS CARPIO L) (IN CZECH), Vyzkumny Ustav Rybarsky a Hydrobiologicky Vodnany, Prague (Czechoslovakia).

Bulletin VUR Vodnany, Vol 6, No 1, p 11-19, 1970. 2 fig, 9 tab, 21 ref. English summary.

Descriptors: *Ammonia, *Carp, *Nitrogen compounds, *Fish physiology, Water temperature, Toxicity, Toxins, *Ureas. Identifiers: *Cyprinus carpio, Blood serum, Detox-

ification, Brain.

The physiological values were determined of N-ammonia and N-urea in the blood serum of carp in two periods (Sept. - Oct. and Nov. - Dec.). Higher values were obtained in September and October, and may be explained by a more rapid metabolism of nitrogenous substances, connected with a higher water temperature. An acute intoxication of carp results in an increase in blood serum N-ammonia levels (five times); a chronic intoxication causes an approximate five-fold increase as compared with physiological values in each case. The methods of ammonia detoxification of carp is discussed. The level of N-ammonia in the brain of the fish after an experimental acute intoxication with ammonia is more than three times that of healthy fish. The use of these results for diagnostic purposes will be subject to further study. Changes in the levels of N-ammonia in the blood serum and brain of carp during acute intoxication with ammonia were examined. The most pronounced rise of the level of N-ammonia occurs during the first five minutes. The level increases only slowly thereafter. (LeGore-Washington) W71-06732

ABSORPTION OF ENDRIN BY THE BLUEGILL SUNFISH, LEPOMIS MACROCHIRUS,

Louisiana State Univ., Baion Rouge. Industrial Research Lab.

Harry J. Bennett, and John W. Day, Jr. Pesticides Monitoring Journal, Vol 3, No 4, p 201-203, 1970. 1 fig, 16 ref. NIH Grant ES-00276-01.

Descriptors: *Pesticides toxicity, *Organophosphorous pesticides, *Endrin, *Sunfishes, *Toxicity, Pesticides, Lethal limit, Absorption, Toxins, Agricultural chemicals, Fish, Fish physiology, Fish toxins.

Identifiers: *Bluegill, *Lepomis macrochirus, TLm, Gastrointestinal tract, Liver, Muscle.

Endrin absorbed by bluegill sunfish in lethal and sublethal concentrations was determined by electron capture gas chromatography. The amount of absorption was measured for the entire body, absorption was measured for the entire body, skeletal muscle, liver and gastrointestinal tract over 24 hr. At the lethal level (2.0 ppb), all the tissues absorbed increasing amounts of endrin throughout the tests. At the sublethal level (0.2 ppb), the entire body, skeletal muscle and liver exhibited an Nshaped absorption curve, with an initial sharp rise in endrin levels, followed by a drop, with a subsequent rise. This implies development of a temporarily effective mechanism for coping with the endrin. At the 0.2 ppb level, the gastrointestinal tract absorbed increasing amounts of endrin throughout the tests. (LeGore-Washington)

KINETIC MODEL OF FISH TOXICITY THRESHOLD,

California Univ., Berkeley. Dept. of Civil Engineer-

ing. Carl W. Chen, and Robert E. Selleck. Journal of the Water Pollution Control Federation, p 294-308, August, 1969, part 2. 9 fig, 6 tab, 14 ref.

Descriptors: *Mathematical models, *Model studies, *Bioassay, Toxicity, Fishkill, Potassium compounds, Water pollution effects, Laboratory tests. Identifiers: *Kinetic model, *Toxicity threshold, *Threshold concentrations, *Mixtures, *Dilution ratio, Zinc, Cyanide, Antagonism, Synergism.

A procedure is presented which may be used to determine the threshold concentrations of various mixtures of toxicants as well as to evaluate the proportional amounts of toxicity furnished by the individual toxic components, taking into account possible synergistic or antagonistic effects. For experimental verification of the model, zinc and cyanide were selected as toxicants. The survival function describing the fish bioassay data was found to be exponential after an initial induction period. The exponential rate coefficient is a function of at least four other coefficients when the toxicant concentration is maintained constant. The threshold concentrations of zinc and cyanide under the specified experimental conditions are 0.33 and 0.236 mg/l, respectively. (Sjolseth-Washington) W71-06734

RELATIONS BETWEEN THE STRUCTURE OF CHLORAMPHENICOL AND ITS VEGETALIZ-ING EFFECTS ON SEA URCHIN, PARACEN-TROTUS LIVIDUS, EGGS (IN FRENCH), Station Zoologique, Villefranche-sur-Mer

(France). R. Lallier.

Acta Embryologiae et Morphologiae Experimentalis, Vol 10, p 280-287, 1968. 1 fig, 25 ref. English

Descriptors: *Physiological ecology, *Biochemistry, Inhibition, Chemical reactions, Embryonic growth stage, Mode of action, Chemicals, Proteins, Synthesis, Aquatic animals, Aquatic environment, Pollutants, Bioassay, Nitrogen compounds, Eggs, Invertebrates.

Identifiers: *Chloramphenicol, *Sea urchin eggs,

*D-threo-chloramphenicol, *Chemical structure, *Nitrobenzene, *Alanine, Benzene, Developmental inhibition, Sterioisomers, Protein synthesis.

effects of various chloramphenicol on the differentiation of sea urchin eggs were studied and compared to the vegetalizing effects of D-threo-chloramphenicol. Its sterioisomer, L-threo-chloramphenicol, in-hibited development, but no vegetalizing effect was observed. The substitution of the nitro group in the D-isomer by an aminosulphonyl (sic) group (D-AMP-3) or by a methylsulphonyl group (D-thiophenicol) suppressed the vegetalizing action, and also inhibited development. With the substitu-

Group 5C-Effects of Pollution

tion by a thiomethyl group (D-Win 5094), the vegetalizing activity was greatly reduced. Various nitrobenzene derivatives (p-nitrophenol, p-nitrobenzoic acid, p-nitrophenylhydrazine) inhibited development. L-beta- (nitrophenyl)-alphalalanine reversibly stopped development at the blastula stage. Nitrobenzene and nitroaniline exerted some weak vegetalizing effect, indicated by a low percentage of gastrulas strongly pigmented with small evaginated entodermic vesicles. The nitro group appears to be important for the vegetalizing activity of chloramphenicol. The differential action of D-chloramphenicol on protein synthesis is suggested to explain its vegetalizing effects. (LeGore-Washington)

EFFICACY OF DLN-BUTYL TIN OXIDE ON AN INTESTINAL FLUKE, CREPIDOSTOMUM FARIONIS, IN GOLDEN TROUT,

Wyoming Game and Fish Research Lab., Laramie. Douglas L. Mitchum, and Tom D. Moore. The Progressive Fish Culturist, Vol 31, No 3, p 143-148, July 1969. 2 tab, 3 ref. Dingell-Johnson Project, FW-3-R, Wyoming.

Descriptors: "ChemControl, "Parasitism, "Evaluation, "Fish parasites, "Fish kill, Fish management, Fish hatcheries, Fish diseases, Infection, Bioassay, Toxicity, Laboratory tests, Residues, Animal pathology, Public health, Rainbow trout, Mortality, Trout, Rainbow trout, Antihelminthes (Pesticides). Identifiers: "Crepidostomum farionis, "Di-n-butyl tin oxide, Golden trout, Intestinal flukes, Flukes.

An experiment was conducted to determine whether di-n-butyl tin oxide has anthelmintic properties against Crepidostomum farionis in golden trout. Toxicity experiments were conducted on both rainbow and golden trout. Doses fed to the fish over a three day period were 150, 250 and 350 mg/kg of body weight. Fish were killed periodically after the three day treatment period and examined for flukes. Doses of 150, 250 and 350 mg/kg were 100% effective in eliminating the flukes. Intestinal, digestive tract, internal organs and muscle tissues were assayed for tin. Tin residues were found only in the digestive tract, primarily in the intestine. The data indicate that the tin compound is not readily absorbed by tissues outside the digestive tract and that the compound is rapidly eliminated by trout. (Sjolseth - Washington)

CHANGES IN FISH POPULATIONS AND MIGRATION IN RELATION TO INCREASED SEWAGE POLLUTION IN LITTLE PATUXENT RIVER, MARYLAND,

Maryland Univ., Solomons. Natural Resources Inst. Chu-Fa Tsai.

Chesapeake Science, Vol 11, No 1, p 34-41, 1970. 3 fig, 3 tab, 13 ref.

Descriptors: *Water pollution effects, *Fish populations, *Fish migration, *Sewage effluents, Fish-kill, Fish barriers, Catfishes, White perch, Suckers, Bottom sediments, Dissolved solids, Chlorination. Biological communities, On-site data collections, On-site investigations, Water analysis, Biochemical oxygen demand, Water temperature, Dissolved oxygen, Community development, Maryland, Sunfishes.

Identifiers: *Little Patuxent River (Maryland), *Yearly variations, *Species changes, *Population changes, Smallmouth bass, Black crappie.

Increased sewage pollution in the Little Patuxent River, Maryland from 1958 to 1967 brought about changes in fish migration, abundance of resident species, and the fish community of the stream. The up-stream migration of white catfish, white perch, white sucker, and northern redhorse was apparently adversely affected by the increased sewage pollution. The downstream ranges and abundance of resident smallmouth bass and northern hog sucker decreased as did the upstream ranges and abundance of black crappie. Brown

bullhead, golden shiner, redbreast sunfish, and bluegill showed different degrees of changes in abundance without reduction in their distribution ranges. Number of species and fish abundance decreased drastically in the area immediately below the chlorinated sewage outfalls. Downstream, in the organically enriched areas, the fish community composition changed although there were no changes in number of species. (Sjolseth - Washington)

EFFECTS OF THE HERBICIDE SILVEX ON BENTHOS OF A FARM POND,

Missouri Univ., Columbia. Dept. of Zoology. George L. Harp, and Robert S. Campbell. The Journal of Wildlife Management, Vol 28, No 2, p 308-317, 1964. 1 fig, 3 tab, 21 ref.

Descriptors: *Benthic fauna, *Animal populations, *Aquatic productivity, *Comparative productivity, *Herbicides, Chrysophyta, Farm ponds, On-site investigations, Water pollution effects, Aquatic plants, Pond weeds, Chemcontrol, Gastropods, Oligochaetes, Aquatic insects, Invertebrates. Identifiers: *Silvex, *Chaoborus, Typha an-

Identifiers: *Silvex, *Chaoborus, Typha angustifolia, Potamogeton americanus, Jussiaea, Sagittaria, Leeches.

The bottom fauna of plastic enclosures within a farm pond was investigated before and after treatment with the potassium salt of 2- (2,4,5-trichlorophenoxy) proprionic acid (silvex). Petersen dredge collections were made at 28 day inter-vals, June, 1961 through August, 1962. Six polyethylene enclosures, 12 x 18 ft, were treated with silvex: three at 2.8 ppm and three at 4.6 ppm. One enclosure and the open pond served as controls. The standing crop of benthos doubled numerically and gravimetrically in enclosures treated with heavy concentrations. The increase in numbers of tendipedids and oligochaetes in the treated areas was correlated with increased organic detritus afforded by decomposing rooted aquatic plants. Chaoborus increased greatly in treated enclosures. Libellulids increased one year after treatment. Snails, leeches and coenagrionids appeared to be unaffected by treatment with silvex in the concentrations used. Chrysops decreased quickly in treated areas and reappeared only during the last two months of the study, and only in enclosures treated with the lighter concentrations. The composition of the benthic community of a farm pond and the control of rooted aquatic plants by silvex are described. (Sjolseth - Washington) W71-06739

THE COMPATIBLE EXISTENCE OF NON TARGET SPECIES TO PESTICIDES,

Mississippi State Univ., State College. Dept. of Zoology.

Denzel E. Ferguson.

Bulletin of the Entomological Society of America, Vol 15, No 4, p 363-366, Dec, 1969. 35 ref.

Descriptors: *Resistance, *Pesticide toxicity, Water pollution effects, Biological properties, Compatibility, Animal behavior, Animal physiolo-

Identifiers: *Ecological adaptations, *Behavior adaptations, *Physiological adaptations, Adaptations, Protective mechanisms, Avoidance, Susceptibility.

Three types of adaptation are discussed by which non-target animals may be adapted for survival in a pesticide-contaminated environment. (1) Ecological adaptations such as habitat selection may determine the extent to which an animal is exposed to pesticides. The niche in the food web may govern the amount of pesticide residue accumulated by a species. (2) Behavioral adaptations such as migration and food preference affect pesticide intake. (3) Physiological adaptations such as natural resistance, penetrative power of insecticides and genetic resistance are known to protect some organisms from toxic effects. Although non-target

animals often exhibit numerous mechanisms that protect them against pesticides, most of these mechanisms are of limited value in highly contaminated environments. Also, almost all of these mechanisms involve a dilemma in that one species is benefitted at the expense of another. The need to develop more specific control measures and less persistant chemicals is stressed. (Sjolseth - Washington)
W71-06741

INFLUENCE OF PESTICIDE RUN-OFF IN MONTEREY BAY,
Naval Postgraduate School, Monterey, Calif. Dept.

Naval Postgraduate School, Monterey, Calif. Dept. of Oceanography. E. C. Haderlie.

Marine Pollution Bulletin, Vol 1 (NS), No 3, p 42-43 March 1970.

Descriptors: *DDT, *Pesticide drift, *Pesticide residues, *Water pollution, *Pesticide toxicity, *Surface runoff, *On-site investigations, Pesticide kinetics, Water pollution effects, Aquatic birds, Gas chromatography, Gulls, Crabs, Bottom sediments, Benthic fauna, Estuarine environment, Sea lions, Salinas River, Tissue analysis, California, Heavy metals.

Identifiers: *DDT, *Monterey Bay (California), Bird kill, Cormorants, Grebes, Petrels.

Evidence exists suggesting that runoff from DDT treated farmlands in the Salinas River Valley of California has resulted in pesticide (DDE) contamination of the benthic community and the bottom sediments of Monterey Bay. The Salinas River is the only major tributary entering the bay. A bird kill occurred in Monterey Bay in 1969 after extensive surface runoff from the Salinas Valley. The dead seabirds contained DDE levels as high or higher than anywhere in the area: 805 ppm DDE in the liver of a gull, 412 ppm DDE in the liver of a petrel, and 192-292 ppm DDE in livers of western grebes. A survey being conducted on the benthic community and on the bottom sediments of Monterey Bay is described. It is hoped that this will yield a better understanding of the benthic community of Monterey Bay and of the role played in ecological cycles by heavy metals and by pesticides. (Katz-Washington)

EFFECT OF WATER QUALITY IN BELLINGHAM BAY ON JUVENILE SALMON,

Washington Univ., Seattle. Coll. of Fisheries. D. E. Sjolseth, E. O. Salo, and M. Katz. Preprint, Fifth International Water Pollution Research Conference, San Francisco, 1970. Paper I-26, 27 p, 3 fig. 10 tab, 28 ref.

Descriptors: *Water pollution effects, *Pulp wastes, *Distribution, *Dissolved oxygen, *Fish populations, *Streamflow, On-site data collections, On-site investigations, Chinook salmon, Water quality, Washington, Fish behavior, Distribution patterns, Tidal effects, Fish management, Fish migration, Marking techniques, Salinity, Water temperature, Turbidity, Mortality, Regression analysis.

Identifiers: *Spent sulfite liquor, *Fish catch, Coho salmon, Bellingham Bay Washington, Nooksack River Washington, Townetting.

A two-phase investigation into some ecological factors in the estuarine and freshwater nursery areas that may affect salmon and may influence the behavior of juvenile salmon was conducted on the Bellingham Bay-Nooksack River system in Washington State. No significant correlation was found between dissolved oxygen and spent sulfite liquor. No D.O. levels below 6.6 mg/l and no S.S.L. is above 483 ppm were found. S.S.L. and D.O. were found to have no significant correlation with the catch of salmon. Two salmon streams were studied during the summer to determine coho salmon mortality during a six-week period in late summer. It is the freshwater and not the estuarine habitat

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which is limiting salmon production. (Sjolseth - Washington) W71-06743

LIGNOSULPHONATES IN LAKE PALIANNE.

WATER, Helsinki City Waterworks (Finland), Construction Dept.

For primary bibliographic entry see Field 05B. W71-07027

THE INFLUENCE OF DECOMPOSING SAL-MON ON WATER CHEMISTRY, Alaska Univ., College. Inst. of Water Resources.

For primary bibliographic entry see Field 05B. W71-07057

5D. Waste Treatment Processes

SEPARATE AND COMBINED SEWERS.

Water Wastes Eng. Vol 5, No 12, p 22, Dec 1968.

Descriptors: *Sewerage, Structural design, Systems analysis, Separation techniques.

Identifiers: *Combined sewers, Sewer hydraulics.

This round table discussion describes the general picture of the storm and sanitary sewerage systems, including the ranges and sizes of each of the types of sewers, of the cities the participants represent. Each participant also relates his city's problems in regard to the effect of combined sewers on treatment plants and under conditions of storm flow. Three of the cities have implemented separate sewers, while three others have not undergone separation because of its high cost. Our city has proposed a less costly plan of eliminating ground water seepage into sewers, and the last city (the only one located in Canada) has not yet estimated the cost of separation. W71-06523

SEPARATE AND COMBINED SEWERS.

Water Wastes Eng, Vol 5, No 7, p 26, July 1968.

Descriptors: *Sewers, *Methodology, *Separation techniques, Surveys, Comparative costs. Identifiers: *Combined sewers, Sewer-in-sewers.

Replies by six spokesman from various regions of the United States are given in relation to the following areas of questioning: (1) mile of sewers in the areas investigated; (2) ranges of sizes of each of the sewer types; (3) population serviced by the system; (4) effect of combined sewers on treatment plant operations; (5) surcharging; and (6) plans on sewer separation and costs. W71-06524

REPORT ON PRESSURE SEWERAGE SYSTEM, SUMMER STREET SEPARATION STUDY AREA, BOSTON, MASSACHUSETTS. American Society of Civil Engineers, New York;

and Camp, Dresser and McKee, Boston, Mass.

Combined Sewer Separation Project, Report, Sept, 1968, FWPCA Program No 11020 EKO.

Descriptors: *Cost analysis, *Design, Pressure con-

Identifiers: *Building plumbing separation, *Sewer separation, Boston, Massachusetts, Gravity sewer, Sewage flow variations.

The report studies the design, estimated costs, and evaluates the feasibility of the hypothetical application of the ASCE Project Scheme of pressure sewers for separation in representative combined sewer areas from layouts by the Project staff. The Boston study researched the 53-acre gently sloping, heterogeneous commercial Summer Street Separa-

tion Study Area. The report describes the separation Study Area. The report describes the separation of building plumbing in detail in a typical three-quarter century old five story and basement commercial building 65-ft. by 145-ft. in plan, and estimates the cost of plumbing separation. Four alternative pressure sewer collection systems are indicated with plans and hydraulic profiles. Some systems included in-line main pumping stations. The least expensive complete pressure system, which did not include a main pumping station, is estimated to cost \$4,700,000. Both costs include costs of building plumbing separation \$4,000,000. costs of building plumbing separation, \$4,000,000 for the pressure system including communitors, wet walls and non-clog pumps, and 2,000,000 for the gravity systems. W71-06525

SEPARATION OF COMBINED WASTE WATER AND STORM DRAINAGE SYSTEMS, SAN FRANCISCO STUDY AREA. Brown and Caldwell, San Francisco, Calif.

ASCE Combined Sewer Separation Project Report, FWPCA Program No 11020 EKO.

Descriptors: *Cost analysis, *Design, Pressure con-

Identifiers: *Building plumbing separation, *Sewer separation, Gravity sewer, Plumbing code, San Francisco (Calif), Storage-grinder pump.

The report studies the design, estimated costs, and evaluates the feasibility of the hypothetical applica-tion of the ASCE Project Scheme of pressure sewers for separation in representative combined sewer areas from layouts by the Project staff. The San Francisco study researched the 323 acre predominantly residential, steeply sloping, Launa Street Sewer Service District. The report describes methods of building plumbing separation and in-dicates two alternative arrangements of pressure sewers, with plans and profiles. Estimates of construction cost of each are compared with that of a conventional gravity system of separation designed earlier by the City. Plumbing separation, is estimated to cost about \$5,400,000 for the gravity method and about \$4,400,000 for the pressure method not including storage-grinder-pump units. W71-06527

WATER-POLLUTION ABATEMENT.

F. C. Diluzio.

Am City, Vol 82, No 12, p 21 and 29, Dec 1967.

Descriptors: *Sewers, Pollution abatement. Identifiers: Holding tanks, Treatment processes,

The FWPCA is searching for more effective and less expensive means than physical sewer separation to solve combined-sewer problems. A combination of holding tanks and treatment processes is one method being tested; other alternatives are being examined. W71-06528

COMBINED SYSTEM-SEPARATE SYSTEM,

W. V. D. Emde.

Oesterr Wasserwirtsch (OSWAAI), Vol 19, No 7/8, p 125-130, 1967.

Descriptors: *Investigations, *Sewers, *Sewerage, Hydrograph analysis, Design. Identifiers: *Combined sewers, *Separate system.

In a paper presented at a seminar on canalization held at Raach, Austria, in 1967, the author gave details of investigations into the efficiency of sewerage systems, and outlined the advantages and disadvantages of separate systems as compared with combined systems. Describing the design and construction of each system he emphasized that neither could be regarded as the more efficient, and stressed the need for graphical and hydrographical surveys when sewerage systems are planned and that the final decision must depend on the purposes which the sewerage system is to serve. For small communities, housing estates, and small hotels the combined system can be of advantage, provided the discharge of rainfall and runoff is con-trolled and the quality of the receiving waters is not affected. Where future plans require extensions of sewerage systems, the separate system is more suitable, as long as operational control and plant maintenance are carried out regularly. W71-06529

STORM-WATER TANKS IN COMBINED SEWERAGE SYSTEMS,

D. Londong.

Ber Abwassertech Ver (BABVAD), Vol 19, p 195-

*Design, *Application methods, Descriptors: *Flow control.

Identifiers: *Storm tank, Combined sewers.

The author discusses the important role of stormwater tanks used to prevent and retard the discharge of sudden and heavy rainfalls from combined sewerage system to receiving waters, and he gives details of design calculations for these tanks and their application. W71-06530

STORM-WATER TANKS IN COMBINED SEWERAGE SYSTEMS,

D. Londong

Staedtehyg (STDHAT), Vol 17, No 9, p 199-206,

Descriptors: *Flow control, *Analysis, *Pollution abatement, *Rainfall disposition, Flow rates. Identifiers: *Storm tank, Germany.

Rainwater, discharged from combined or separate systems, can have severe polluting effects on receiving waters especially in industrial areas. Discussing the methods used for reducing such pollution, the author refers to German specifications for three standard types of stormwater retarding tanks, designed to prevent the direct discharge of the first flush of rainfall and to restrict the flow from being carried forward to receiving waters or sewage works. Various methods of calculations for stormwater retarding tanks in sewerage systems are reviewed and compared as to their accuracy. Illustrated details are given of a revised method in which different rates of flow at varying durations of rainfall can be calculated using different parame-

ters. W71-06532

MALLING RDC REGIONAL DRAINAGE SCHEME, D. Lowe.

Surveyor, Vol 82, No 3971, p 29-33, Jul 12, 1968. 5 fig, 1 tab.

Descriptors: *Sewage treatment, *Sewers, *Treatment facilities, *Sewage disposal, *Design, *Con-

Identifiers: *Combined sewers, *Great Britain, Trunk sewer.

Owing to restrictions on the choice of available sites, unusual design and construction techniques were required to build a sewage treatment works which forms part of the 3 million pounds-sterling Snodland-Ightham regional drainage scheme in a rural district of Kent. The Snodland area was mostly sewered on a partially combined system to a totally inadequate sewage disposal works, and the Ditton area's disposal works was heavily overloaded. The basis of the new sewerage system is a trunk sewer laid from a new sewage disposal works. Into this main trunk system flow from area villages will be brought by either pumping or gravity. Solu-tions to each town's problems will be implemented through the use of intercepting sewers, pumping stations, pumping mains, etc. Aspects concerning site selection for the new sewage works are

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discussed, and then the design of the works is detailed. Construction problems and solutions to these problems are explained in regard to both the regional sewerage scheme and the sewage disposal W71-06533

WASTE WATER S METROPOLITAN GREATER WINNIPEG, SYSTEM FOR THE CORPORATION

A. Penman. Water Pollution Control Fed, Vol 39, No 3, p

373-383, Mar 1967.

Descriptors: *River regulation, *Sewerage, Future planning (Projected), Recreation, Urbanization. Identifiers: *Separate system, *Investigations.

The Metropolitan Corporation recognized its duties in restoring the rivers to the requirements of the urban area so that the citizens could use these rivers for recreational purposes. This necessitated the expansion of the existing facilities and the addition of new facilities. Sewer rentals and industrial wastes were two major areas investigated. A separate sewer system was looked into by both city and consulting engineers. It was decided that the \$200 million plus cost of intercepting the old combined system was not feasible; however, future development of areas along the Red and As-siniboine Rivers will be based on separate sewer systems. W71-06534

PROBLEMS OF COMBINED SEWER FACILI-TIES AND OVERFLOWS,

R. H. Sullivan.

J Water Pollution Control Fed, Vol 41, No 1, p 113-121. Jan 1969.

Descriptors: *Surveys, *Effects. Identifiers: *Combined sewers.

The author summarizes and discusses some of the principal points found during a survey, carried out by the Federal Water Pollution Control Administration, on the problems caused by combined sewers. W71-06535

OPERATION OF SEWERAGE WORKS FOR BU-DAPEST.

M. Szilagyi.

Paper presented at a conference on the Construction of Complex Supply Installations at Budapest, 1968, Theme No 4.4.

Descriptors: *Sewerage, *Sewers, *Surveys. Identifiers: *Hungary.

The built-up area of Budapest covers 23,700 ha, of which 9400 ha are connected to the sewerage system. In 1966 the length of the sewer network has about 2000 km. There were 32 sewage works and pumping stations, and the quantity of sewage and rainwater discharge amounted to over 300 million m cu. The annual volume of sludge removed from the sewer amounted to 60,000 m cu. W71-06536

COMBINED SEWERS MAY BE AN AD-VANTAGE,

Am City, Vol 85, No 1, p 68-70, Jan 1970.

Descriptors: *Sewers, *Design, Storm runoff. Biological treatment, Separation techniques. Identifiers: *Kenosha, Wisconsin, *Combined sewers, Sludge treatment plants.

An alternative to separation, which utilizes combined sewers in conjunction with activated sludge treatment plants, is being put into operation in Kenosha, Wisconsin through a FWPCA grant. The plant employs the biological-adsorption process

and can treat up to 20 mgd of combined sewage. Details of how the system works are included as well as a flow sheet diagram of the plant. The plant will save the city at least \$6 million over sewer separation and during dry weather portions of the system can supplement normal plant operations. The plant will treat flow from only 70-80% of the storms, but because of the 'first flush' action of storm runoff, the greatest bulk of BOD and suspended solids will be captured. Parameters to be measured and evaluated to determine the efficient cy of the system are listed. W71-06537

COMBINED SEWERS IN CANADA,

Eng J, Vol 52, No 6, p 22-30, Jun 1969, Paper presented at the Annual General Meeting of the Engineering Institute of Canada, May 29-31, 1968.

Descriptors: *Sewers, *Surveys, Overflow, Separation techniques.
Identifiers: *Combined sewers, *Canada.

The author presents a survey of combined sewers in Canada similar to the one he undertook in 1967 on the same subject in the United States. Even when combined sewers are large enough to carry peak storm flows in addition to domestic sewage, they do not provide the higher velocities in dry weather that are needed to prevent solid deposition. Thus, up to 1/3 the annual production of solids and BOD may be overflowed during storms and held back from treatment. Problems such as these necessitated this study which provides information in four main areas: (1) the extent and distribution of Canada's combined sewers; (2) the prevailing attutudes and policies in regard to combined sewers;
(3) factors influencing these attitudes and policies; and (4) descriptions of methods proposed and adopted to diminish overflows from combined sewers. A majority of the population surveyed considered combined sewer overflows to be a nuisance. Separation is too expensive to warrant institution in most communities. Some combined systems have not yet developed to the point where they include overflow, and in some areas the pollu-tion from this source is not considered to be a problem. More information is needed regarding ess-costly alternatives to separation. Separation should be implemented without delay for flood relief, when combined sewers are replaced and in new construction, or in plumbing for new buildings. These programs are not overly expensive, and they leave open the option of instituting alternatives which future technology may uncover. W71-06538

AVONMOUTH INDUSTRIAL ESTATE--UNUSUAL DRAINAGE SCHEME, K. J. West.

J Inst Munic Engrs, Vol 95, No 12, p 363-367, Dec

Descriptors: *Drainage systems, *City planning, Urbanization, Sewerage, Separation techniques. Identifiers: *Great Britain, *Combined sewers.

Systems of drainage considered for the City of Bristol, England include: a separate system with stormwater draining to rhines; a separate system with stormwater draining through pipes to existing outfall culverts; and, combined systems. The combined sewerage system was adopted for a major part of the estate. W71-06539

STOKE SEWER RENEWED AFTER CRUDE SEWAGE OVERFLOW.

Surveyor, Vol 85, No 4049, p 38-39, Jan 16, 1970.

Descriptors: *Sewerage, *Sewers, *Treatment facilities, *Control structures, Control systems, Contracts, Construction. Identifiers: *Great Britain.

A sewerage reconstruction program in the Burslem area of Stoke-on-Trent involves a four-stage renewal of the sewer system and reconstruction of the water pollution control works. Old sewers were in poor structural and hydraulic condition, and several sections of the main outfall sewer upstream of the treatment works collapsed causing crude sewage to overflow and form a large lake of sewage. Two contracts provided a sanitary sewer from the works plus a surface water culvert connecting with a feeder to the River Trent. A third contract provided a separate storm and sanitary system connecting the old sewer network with the sewer and culvert constructed previously. Other structures built under the contract are described. W71-06540

OUTLINE DESCRIPTION OF ASCE PROJECT ON 'SEPARATION OF SANITARY SEWAGE FROM COMBINED SYSTEMS OF SEWERAGE'. American Society of Civil Engineers, New York.

ASCE Combined Sewer Separation Project, Technical Memorandum No 1, Feb 21, 1966, FWPCA Program No 11020 EKO.

*Pressure conduits, Separation

Identifiers: *Combined sewers, *Sanitary sewage, Comminuted sewage.

Descriptions of the project separation scheme, project goal and project background are given. The general concept of the ASCE Project scheme is to pump cumminuted sanitary sewage from individual buildings and building complexes through relatively small pressure tubing laid in existing building connections and thence into new pressure conduits suspended in existing street sewers. Potential advantages of the scheme are discussed. The project wishes to develop feasible designs and operations and to test them in actual systems. The immediate objective is to examine and evaluate both the feasibility and probable cost. The background of the project is reviewed. An appendix summarizes the need for separation of combined sewerage systems and the national scope of the problem. W71-06541

MASSIVE SEWER INFILTRATION,

Thomas E. Llewellyn. Am City, Vol 83, No 10, p 90-91, Oct 1968.

Descriptors: *Maintenance, *Repairing, Infiltra-

The North Tahoe Public Utility District instituted a massive sewer repair program after it discovered that sewage flows were highly excessive. Snow Creek and Lake Tahoe were becoming polluted, 200 manholes were leaking and permitting entrance of surface and groundwater, and many lateral sewers were causing infiltration. Smoke bombs employed to pinpoint offenders disclosed storm inlets connected to sanitary sewers. Methods used to correct violations and sewer defects are described. W71-06542

SUBURB MEETS URBANIZATION HEAD-ON. Water Wastes Eng, Vol 4, No 11, p 47-49, Nov

Descriptors: *Sewerage, *Design, Costs, Michigan. Identifiers: *Storm sewers, Expenditures.

The city of East Lansing, Meridian Township Board, and Michigan State University jointly agreed to provide a municipal sewer system for the fast-growing college and recreational area in Ingham County, Michigan. The original septic tanks were connected to storm sewer systems which led to a newly constructed sewage treatment plant. Financial problems and an itemized list of expenses are discussed. W71-06551

Waste Treatment Processes—Group 5D

POLLUTION ABATEMENT THROUGH SEWER

SYSTEM CONTROL,
W. T. Eiffert and P. J. Fleming.
Journal Water Pollution Control Federation, Vol 41, No 2, p 285-291, Feb 1969.

Descriptors: *Waste water treatment, *Pollution abatement, Sewers, Sewerage.

Identifiers: *Storm sewer pollution, *Dayton, Ohio.

Concurrent with a major waste water treatment plant expansion program in Dayton, Ohio, for ef-fluent release into the Great Miami River, a four point program has been initiated to eliminate pollupoint program has been initiated to eliminate pollu-tion from storm sewers. Although Dayton has a separate sewer system, untreated industrial plant wastes and municipal by-passes must be eliminated to insure the 90 to 95 percent pollution reduction required by water quality standards. W71-06557

DUNFERMLINE PAST, PRESENT AND FU-

For primary bibliographic entry see Field 05G. W71-06562

OHIO STORMS BURST TWO RESERVOIRS. For primary bibliographic entry see Field 05G. W71-06563

LEAST COST SAND FILTER DESIGN FOR

IRON REMOVAL, Iowa State Univ., Ames. Dept. of Civil Engineering; and Iowa State Univ., Ames. Engineering Research Inst.

Jerry Y. C. Huang, and E. Robert Baumann.

Journal of the Sanitary Engineering Division,
ASCE, Vol 97, No SA 2, p 171-190, April 1971. 20
p, 5 fig, 9 tab, 7 ref, 1 append.

*Optimization, *Mathematical models, *Design, *Computer programs, Operating costs, Flow rates, Head loss, Sewage treatment. Identifiers: *Least cost analysis, *Sand filtration, *Iron removal.

An empirical filter performance prediction model was used in developing a computer program for predicting sets of equivalent sand filter designs and their first and operating costs. It was confined to a consideration of studies of the optimization of influent control, single-media sand filters to remove iron from suspension in water. The effects on the cost of the filter system of pertinent variables such as sand size, sand depth, terminal head available, flow rate, and run length were evaluated. Of the variables affecting filtration performance, the two held constant were: (1) kind of influent suspended solids; and (2) method of filter operation. The performance prediction model assumed that the flow rate remained constant during a filter run. For all sand sizes studied (0.6 mm to 1.3 mm), the optimum design filtration rate (4.0 gpm per sq. ft. - 5.5 gpm per sq. ft.), run length (32 hr. - 42 hr.), and terminal head loss (8 ft. - 11 ft.) all closely approximated values used in current practice. The optimization techniques developed to predict both the filter designs providing equivalent performance and their costs have potential application in design of new filtration plants and prediction of operating conditions, such as run length and effluent quality, of existing sand filtration plants. (Kriss-Cornell) W71-06585

THE TIDAL THAMES 1967.

Effluent Water Treat J, Vol 8, No 9, p 463-465, Sep 1968.

Descriptors: *Pollution abatement, *Design, Sewerage, Estuaries, Storm runoff. Identifiers: Thames River, Storm sewage, Great Britain.

The article concerns aspects of pollution control along the tidal river. The greatest effect of the

discharge from the Greater London Council sewage works on the tidal Thames originated from the outfall works at Beckton. A scheme for reduction in storm sewage discharges from the sewerage system leading to the Beckton works was being examined. New trunk sewers, a pumping plant, and storm sewage tanks would be most likely involved in the scheme. The cost of the Beckton improvements was estimated at 21 million pounds, and of the improvements of the sewerage and storm sewage disposal systems at 22 million pounds. W71-06629

WHAT TO DO WITH SEWAGE WHEN IT RAINS HARD.

Eng News-Record, Vol 178, No 16, p 30-31, Apr

*Tunnel construction, *Tunnels, Storm runoff, Water treatment, Control systems. Identifiers: *Chicago.

Chicago is building a \$14.4-million deep tunnel system to carry spillages from combined storm and sanitary sewers during rainfall. The FWPCA has indicated four main areas related to stormwater runoff problems which require further study and demonstration: drainage area control; collection system control; external discharge control, including treatment of both combined sewer overflow and stormwater run-off; and a miscellaneous area, consisting of the economic feasibility of substituting separate sewers for combined sewers and local for central treatment facilities, better hydrologic analyses, new management procedures, construction materials and methods, and the development of performance criteria for standards of water quality. W71-06631

WATER MONEY NEEDS REQUIRE MORE THAN PROMISES.

Environ Sci Technol, Vol 4, No 4, p 278, Apr 1970.

Descriptors: *Pollution abatement, Water treat-

Identifiers: Waste treatment costs, Sewered population statistics.

S. 3472, the program for water pollution cleanup, calls for \$10 billion for construction of municipal waste treatment plants. Among spokesmen at the 4th Annual Legislative Seminar concerned with the continuing cleanup is James R. Ellis who states that cities are in a catch-up situation. According to Ellis, 35% of the sewered population in the United States received 5% of the federal dollar during the period 1965 - 1969. Some of Ellis' suggestions are cited. John L. Salisbury, a Maine spokesman, contends that the need for secondary treatment is being challenged. W71-06632

ENVIRONMENTAL RESEARCH IN S.E. ASIA.

Water Waste Treatment, Vol 12, No 12, p 392-396, Mar/Apr 1970.

Descriptors: *Storm runoff, *Sewage treatment, Water pollution, *Foreign research. Identifiers: *Thailand.

The Thailand government's decision to plan for drainage and sewerage in Bangkok has led to increased research at the Asian Institute of Technology in Bangkok. Studies relating to stormwater collection, river pollution, and sewage treatment have been made in cooperation with interested authorities; and the results are applicable not only to Bangkok's project but also to other tropical regions. Topics of pertinent research projects include: (1) the anaerobic treatment of tapioca starch waste; (2) characteristics of treatment of Bangkok septic-tank sludge; (3) a Bangkok runoff hydrograph; (4) the ecology of polluted canals in Bangkok; (5) a study of photosynthetic oxygen production in the Chao Phya River; (6) pollution of the Chao Phya River, Bangkok; and (7) oxygen balance in the Chao Phya River estuary. Research is also proceeding on industrial waste treatment in Southeast Asia including studies on design criteria for waste stabilization ponds and sludge drying beds, and the progress of biological assimilation of wastes in a tripical climate. Water treatment is another area currently being investigated. W71-06635

REPORT OF COMMISSION TO INQUIRE INTO AUCKLAND ALLEGED NUISANCES METROPOLITAN DRAINAGE DISTRICT.

New Zealand House of Representatives, 1965. 32

Descriptors: *Sewage treatment, Evaluation, Remedies. Identifiers: *New Zealand.

This report, on the investigation of nuisances caused by midges and offensive odors at the Man-gere sewage works of the Manukau Sewerage Scheme, Auckland, deals with the causes of these nuisances, possible methods of elimination, and the necessity for legislation. Since much of the nuisance is attributable to the sewage reaching the works in a stale condition, it is recommended that the Orakei combined sewerage system be cleaned at least once a year, regular sampling be carried out during periods of low flow, provision be made for the injection of compressed air at each pumping plant to minimize septic conditions in the pressure mains, and the inverted siphons be flushed at least once a week during the dry season. Certain modifications are also recommended at the sewage works, including the covering of preliminary aeration and primary sedimentation tanks, the use of percolating filters to regulate the load on the oxidation ponds, and the reduction of recirculation of effluent to increase the period of sedimentation and the amount of sludge digested. In view of the increasing population, the design load of the works for a population of 800,000 will possibly be reached by 1986; and since the existing oxidation ponds cannot be extended economically, investigations are necessary to determine the best process for the extensions. It is proposed to consider the activated-sludge process. W71-06637

CONCEPT THE OF MUNICIPAL SEWERAGE SYSTEMS,

H. Fathmann. IWL Forum 66/1, p 1-23, 1966.

Descriptors: *Sewage treatment, *Costs *Drainage systems, *Equipment, Design.

The author deals with various problems which are encountered in the design and operation of sewage works for local communities. Particular reference is given to the cost of drainage systems and mechanical treatment plants, the control of storm sewage overflows, the operation of screens, detritus, sedimentation and humus tanks, and the advantages of percolating filters and activatedsludge plants. W71-06654

PROPOSED FEDERAL FUNDING FOR CON-STRUCTION OF COMMUNITY WATER AND SEWAGE FACILITIES.

For primary bibliographic entry see Field 06E. W71-06689

PRACTICAL ASPECTS OF THE DESIGN OF WASTE STABILIZATION PONDS, Wooton (L.E.) and Co., Raleigh, N.C. W. D. Barlow

Group 5D—Waste Treatment Processes

Ninth Southern Municipal and Industrial Waste Conference Proceedings (North Carolina State University, Raleigh, North Carolina, April 7-8 1960) p 65-74, Technical Press, Raleigh, North Carolina, 1960.

Descriptors: *Lagoons, *Domestic wastes, Waste water treatment, Industrial wastes, Nutrients, Bacteria, Algae, Treatment facilities, Test procedures, Metals.

Identifiers: *Finishing wastes.

Lagoons can be designed to provide complete treatment for any waste water, domestic and/or industrial, provided it contains the necessary nutrients and is free from substances which are toxic to bacteria or algae. The author discusses the basic processes involved; factors affecting the design and operation of the lagoon (particularly under conditions in North and South Carolina); performance of the lagoon, including methods of measurement; and precautions to be taken to avoid health hazards, pollution and other nuisance problems. In discussion, reference was made to lagoons used for treating mixed waste waters and 20-30 percent of domestic sewage, and especially to the problems encountered which appear to be caused by toxic metals in the waste water. (Livengood - North Carolina State University) W71-06737

COMBINED TREATMENT OF TEXTILE AND DOMESTIC WASTE, Cannon Mills, Kannapolis, N.C.

John L. Brown.

Southern Municipal and Industrial Waste Conference Proceedings (North Carolina State University, Raleigh, North Carolina, April 1-2, 1957) p 179-186, Technical Press, Raleigh, North Carolina,

Descriptors: *Standards, *Legislation, *Waste water treatment, Domestic wastes, facilities, Lagoons, Trickling filters, Settling basins, Chlorination, Sludge digestion, Textiles. Identifiers: *Textile wastes, Sodium hydroxide.

Steps taken by Cannon Mills Company to treat plant waste to comply with state stream pollution laws are described. The treatment plant consists of the following units: a storage lagoon for caustic waste, primary settling tanks, two-stage trickling waste, primary settling tanks, two stage threking filters, secondary settling tanks, a CI contact tank, and a sludge digestor. The combined waste being created through the plant is about 60% textile waste and 40% domestic sewage. (Livengood -North Carolina State University)

TARGET DATES FOR SECONDARY TREAT-MENT AND STORMWATER SEPARATION ON LOWER MISSOURI AND MISSISSIPPI RIVERS, Glen J. Hopkins.

Paper presented at the annual meeting of the Missouri Water Pollution Control Association, Jefferson City, Missouri, February 23, 1970.

Descriptors: *Water pollution sources, *Pollution abatement, Missouri River, *Mississippi River, *Surface runoff, Water pollution, Sewage treatment, Separation techniques, Overflow, Waste water treatment.

Identifiers: *Agricultural land runoff, Combined

Sources and effects of pollution in the lower Missouri and Mississippi Rivers are discussed, and reasons for opposing secondary treatment and storm sewer separation for this area are explained. He states that sufficient pollution abatement has already taken place in these rivers and that communities need not waste tax dollars supporting federal grants for further pollution prevention facilities. According to Mr. Hopkins, the Missouri River can assimilate wastes properly with the treatment that is presently offered. He also asserts that sewered wastes, municipal and industrial, and combined sewer overflows cause far less pollution to the rivers than does surface runoff from agricultural lands upstream. Cost of sewer separation for this area is estimated to exceed \$250 million. W71-06744

WATER RESOURCES AS AN ELEMENT OF URBAN PLANNING.

For primary bibliographic entry see Field 05B. W71-06753

SYSTEM DESIGN,

For primary bibliographic entry see Field 08B.

WOOL GREASE RECOVERY FROM SCOUR-

ING EFFLUENT, Head Wrightson and Co., Ltd., Thornaby (England). E. B. Chandler.

Patent No 964,430, July 22, 1964.

Descriptors: *Flocculation, Filtration, Chemical precipitation, Waste water treatment. Identifiers: *Wool scouring, *Wool grease, *Calcium chloride.

Waste water from wool scouring, containing up to 2% of grease at a pH of 10-12 and an oxygen demand of 3-4000 p.p.m. as determined by a four hour permanganate test is treated with calcium chloride so as to give a residual hardness of 1-4000 p.p.m. To improve flocculation and subsequent filtration small amounts of polyelectrolytes or other aids may be added. After removal of solid materials by means of vacuum filtration the waste water conby means of vacuum litration the waste water contains 10-40 p.p.m. grease and has an oxygen demand of 600-1200 p.p.m. by the permanganate test. The grease may be recovered from the filter cake by solution in chlorinated organic solvents. (Work-North Carolina State University) W71-06782

AREAWIDE WATER AND SEWER PLAN.

Harrison City Planning Commission, Ark. For primary bibliographic entry see Field 04A.

WATER AND SEWERAGE FACILITIES PLANNING PROGRAM FOR MADISON, ST. CLAIR AND MONROE COUNTIES, ILLINOIS. PHASE I-PROGRAM DESIGN.

Southwestern Illinois Metropolitan Area Planning

Commission, Collinsville. For primary bibliographic entry see Field 06B. W71-06794

A SIMPLIFICATION OF TEXTILE WASTE SURVEY AND TREATMENT,

Wesleyan Univ., Middletown, Conn. Industrial

J. W. Masselli, N. W. Masselli, and M. G. Burford. Wesleyan University, Middletown, Conn, 1959. 68 p, 15 fig, 16 tab, 41 ref.

Descriptors: *Water pollution sources, *Water pollution control, *Data collections, *Waste water treatment, Cotton, Pollution abatement, Evaporation, Incineration, Coagulation, Calcium chloride, Activated sludge

Identifiers: *Pollution load, *Textile mill wastes, Finishing wastes, Wool, Desizing wastes, Kiering wastes, Scouring wastes, Washing wastes, Waste water segregation, Waste water analysis, Dyehouse

This report contains an outline of the processing methods and sources of pollution in the finishing of cotton, wool, and man-made fibers; advice on the simplification of pollution survey methods in the textile industry; an assessment of the range of pollution load from specific processes; and suggestions on the reduction of pollution load and simplifica-

tion of methods for treating the waste waters. In cotton mills, most of the pollution results from desizing and kiering operations, and in woolen mills, from scouring and washing after fulling; and it is emphasized that the first step towards pollution control should be the modification of processes to segregate these wastes as a single concentrated waste water which would require only small storage capacity to permit equalization of the discharge of BOD over 24 hours instead of shock loads and would also separate the toxic and other troublesome constituents of the weaker effluents which are normally responsible for the great variability in textile waste waters and prevent adequate treatment. The segregated concentrated waste water could be treated by evaporation followed by incineration. The woolen mill waste could be treated by chemical coagulation with calcium chloride and the cotton mill waste, after dilution, by biological filtration or the activated-sludge process. The pollution loads of the remaining weaker effluents, and also of the waste waters from the finishing of man-made fibers, are entirely due to chemicals used in processing; suitable chemicals should therefore be developed which have lower BOD values or are easily removed from the waste waters. Other research should include the development of methods for recovering materials from the waste waters or utilizing the waste waters; the col-lection of data on the BOD of processing chemicals; and basic research on the reactions of sub-stances primarily responsible for the BOD of the waste waters (principally glucose, soap, and natural impurities). Numerical data are appended on the impurities). Numerical data are appended on the composition and BOD of the various processing chemicals, the analysis and pollution potential of typical waste waters, and the removal of BOD by chemical coagulation. (Livengood-North Carolina) W71-06800

ODOR CONTROL IN CATTLE FEED YARDS, For primary bibliographic entry see Field 05G. W71-06803

ACCELERATION OF NATURAL DRYING OF POULTRY MANURE THROUGH MECHANICAL AGITATION,

California Univ., Davis. For primary bibliographic entry see Field 05G.

CONTROLLING ODORS FROM CATTLE FEED LOTS AND MANURE DEHYDRATION OPERA-TIONS.

Memphis Cattle Feeders, Inc., Millington, Tenn. For primary bibliographic entry see Field 05G. W71-06805

USE OF SOIL TO TREAT ANAEROBIC LAGOON EFFLUENT: DESIGN AND OPERA-TION OF A FIELD DISPOSAL SYSTEM, Iowa State Univ., Ames. Dept. of Agricultural En-

gineering.
Dale H. Vanderholm, and Craig E. Beer.

Transactions of the American Society of Agricultural Engineers, Vol 13, No 5, p 562-564, Sept-Oct 1970. 1 tab, 2 fig, 17 ref. OWRR Project A-021-IA

Descriptors: *Farm wastes, *Disposal, *Anaerobic digestion, *Irrigation systems, Runoff, Farm lagoon, Livestock, Pollutants, Biochemical oxygen demand, Chemical oxygen demand, Nitrogen, Odor, Storage capacity.
Identifiers: *Land requirements, Livestock wastes.

The study was initiated to investigate the pertinent variables involved and evaluate the performance of an irrigation system for the disposal of livestock waste. It was desired to determine irrigation rates, frequencies, and quantities that would result in satisfactory renovation of the lagoon effluent with

no detrimental effects. The results indicate, that for waste-water irrigation, the tabulated rates for clear water are too high and should be reduced, possibly

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Waste Treatment Processes—Group 5D

30 to 50 percent. The average COD removal was 97 percent. Smaller applications made more frequently were the most efficient for COD reduction. 80 percent of the nitrogen is removed. 99 percent of the phosphates were removed. This method of waste disposal appears feasible. The results of the study indicate an optimum level for the observed soil and climatic conditions of about 2 in. of lagoon effluent per week during the growing season. (Christenbury-Iowa State) W71-06806

INDIAN UTILIZES NOVEL MANURE DISPOSAL SYSTEM.

Patel Poultry Farm, Boroda (India).
Jawahar D. Patel. Poultry Digest, Vol 26, p 100-101, 1967.

Descriptors: *Farm wastes, *Methane, *Gases, *Anaerobic digestion, Fertilizers, Odor, Tempera-ture, Disposal, Poultry, Fuels. Identifiers: India, Working details.

An anaerobic digester that converts poultry manure into useful methane gas is being utilized in India. Poultry manure gives 1.5 to 2.0 cu. ft. of gas per pound in a short period of digestion and at a temperature of 35 degrees C. 35.3 cu. ft. of methane is equivalent to 2.2 kilowatt-hours of electrical energy. The digested manure is a valuable fertilizer because it supplies not only nutrients such as nitrogen, phosphorus, potash, iron, copper, cobalt, maganese, calcium, magnesium, etc., in a well-balanced proportion, but also most valuable humus to plants for successful crop production. (Christenbury-Iowa State) W71-06807

POULTRY LITTER AS CATTLE FEED,

Missouri Univ., Columbia. Dept. of Animal

Melvin Bradley, and Walter Russell. Feedstuffs, Vol 37, No 8, p 59-60, February 20,

Descriptors: Farm wastes, Legal aspects, Feeds, Missouri, Poultry, Hazards, Efficiencies. Identifiers: Broiler litter, Bloat, Rate of gain.

This article reviews the literature on feeding of poultry litter to beef cattle, discussing hazards and legal implications and giving recommendations if litter is used as a feed. Research is reviewed from Texas, Arkansas, Georgia and Virginia. (Christenbury-lowa State) W71-06808

BOD OF CAPTIVE WILD ANIMAL WASTES,

Tulane Univ., New Orleans, La. Dept. of Civil Engineering. F. W. Macdonald, and H. R. Davis.

Water and Sewage Works, Vol 113, February 1966, p 64-67. 2 tab, 2 ref.

Descriptors: *Biochemical oxygen demand, Animals, Animal wastes (Wildlife).

Identifiers: *Wild animals, *Zoo, Total solids, Captive animals, Primates.

The findings of an analysis of the animal waste from a zoo are reported. The total solids and the BOD per pound of animal are reported. The results of this study may well serve as a guide in the design of plants for the disposal of wild animal wastes. (Christenbury-Iowa State) W71-06809

PROCEEDINGS OF FARM ANIMAL WASTE AND BY-PRODUCT MANAGEMENT CON-FERENCE.

Wisconsin Univ., Madison. For primary bibliographic entry see Field 05G. W71-06810

CONSIDERATIONS IN SELECTING DAIRY MANURE DISPOSAL SYSTEMS,
Wisconsin Univ., Madison. Dept. of Agricultural

For primary bibliographic entry see Field 05G.

W71-06819

ENGINEERING RESEARCH ON FARM ANIMAL MANURE, Wisconsin Univ., Madison. Dept. of Agricultural

Engineering.
For primary bibliographic entry see Field 05G. W71-06820

NATION-WIDE RESEARCH ON ANIMAL WASTE DISPOSAL,

Federal Water Pollution Control Administration, Chicago, Ill. Lake Michigan Basin Office For primary bibliographic entry see Field 05G. W71-06821

THERE'S HOPE AHEAD,

Wisconsin Univ., Madison. Dept. of Poultry Science.

For primary bibliographic entry see Field 05G. W71-06823

WASTE DISPOSAL--WATER TREATMENT PLANTS (JOINT DISCUSSION).

For primary bibliographic entry see Field 05E. W71-06846

THE LARGEST BIOLOGICAL SEWAGE-TREATMENT PLANT ON THE CONTINENT.

Ber Abwassertech Ver (BABVAS), Vol 18, No 2, V, 1967.

Descriptors: *Biological treatment, *Sewage treatment, *Sludge treatment, Channels, Waste water treatment Identifiers: Germany.

An account is given of plans for a large biological treatment plant to be built in Essen, Germany, to deal with the increasing quantities of sewage to re-lieve the existing Einscher plant. The new plant will be able to treat a load of 20 m cubed per second, and during rainfall this amount can be increased to 30 m cubed per second. Provisions have also been made to construct the influent and effluent channels of the mechanical stage in such a way that a loading of up to 45 m cubed per second would be possible. The section where the preliminary treatment is carried out is to be built below ground so that incoming sewage can enter without pumping; the biological stage will then be built above ground and the sewage will be pumped into individual tanks accomodated in 3 buildings. The plan for separate units applies to the whole plant for convenience of necessary repairs. Special provision is made for the separation of oil. Oxygen is supplied mechanically to the aeration tanks, which will have a total volume of 180,000 m; the final sedimentation tanks will also have a volume of 180,000 m cubed. Primary sludge, amounting to about 60% of the total sludge, is to be transported to the sludgedrying plant in Essen-Karnap via a pressure pipeline. Experiments are at present being carried out on methods for disposal of excess activated sludge. W71-06847

10,000 FT LONG SEA OUTFALL AT HASTINGS IN SUSSEX.

For primary bibliographic entry see Field 05E. W71-06848

RE-USING STORM RUN-OFF.

Environ Sci Technol, Vol 2, p 1001-1005, 1968.

Descriptors: *Design, *Cost analysis, Lakes, Potable water, Runoff, Maryland, Waste water treatment, *Water reuse. Identifiers: *Columbia (Md).

A design and cost study of the 1100-acre Wilde lake watershed in Columbia, Md., which considers the treatment of runoff and its use as potable water, is described. The scheme includes the collection and storage of runoff in 10 small lakes and preliminary treatment there by sedimentation, chemical coagulation, and chlorination.

TRANSMISSION PLANT TREATS 100,000 GPD.

Modern Power Eng, Vol 64, No 6, p 64-66, Jun 1970. 2 tab, 1 diag.

Descriptors: *Waste water treatment, *Sewers, *Sewage treatment, *Industrial wastes, Separation techniques, Water distribution (Applied), Storm runoff

Identifiers: Interceptor sewer.

Prior to installing General Motors' automatic transmission treatment plant, plans were made for the separation of industrial wastes from other liquid wastes. Separation of sewage and sanitary wastes was accomplished by laying interceptor sewers from washrooms to connect to municipal sewers. Stormwater was separated through the construction of an overhead collection system connected to rainwater leaders from the roof. Clean cooling water from production operations was also pumped into this overhead collector and the contents fed to municipal storm systems. Industrial waste purification was accomplished through the installation of the complex waste treatment plant, which is described in detail and which, since September 1968, has passed only treated industrial wastes to municipal sewers. W71-06850

PHASE 1 EXTENSION WILL CATER FOR EXTRA 1.7 M.G.D. FLOW.

Munic Eng (London), Vol 146, p 756, 1969.

Descriptors: *Sewage treatment, Humus, Sedimentation, Filtration, Waste water treatment. Identifiers: Great Britain, Storm tank

An illustrated description is given of extensions in progress to the Tixall sewage works of the Stafford Borough Council, including humus, sedimentation, digestion, and storm sewage tanks, additional percolating filters, and a building to house filter presses. The extended works, which also treats sewage from an area administered by Stafford R.D.C., will have a treatment capacity of 3.6 m.g.d. W71-06851

COMBINED SEWAGE WORKS OPERATING AT FARINGDON.

Munic Eng (London), Vol 146, p 1221, 1969.

Descriptors: *Sewage treatment, *Storm runoff, *Biocontrol, Waste water treatment. Identifiers: *Combined sewers, discharge, *Biological filtration, Great Britain.

An illustrated description is given of the new sewage works served by a combined sewerage system and provided by Faringdon R.D.C., Berks. Treatment is by biological filtration. The final effluent flows into a stream after discharge to a small irrigation area, and excess stormwater is distributed over a 5-acre seepage site from where it drains to the stream through a clinker bed. Crude sludge is dewatered in drying beds. W71-06852

Group 5D—Waste Treatment Processes

FULL TREATMENT CAPACITY INCREASED TO 3.36 M.G.D. BY 29,000-POUND EXTEN-

Munic Eng (London), Vol 145, p 2090, 1968.

Descriptors: *Sewage treatment, Sludge disposal, Waste water treatment.

Identifiers: *Great Britain, Capacity, Storm sewage

Recent extensions to the sewage works of Fleet, Hants., which have increased capacity to a dry-weather flow of 1.12 m.g.d., are described. Addi-tional facilities include sludge-drying beds with mechanized removal of sludge, and modifications have been made to humus tanks and percolating filters to provide more working volume. The humustank effluent passes through microstrainers before discharge and storm sewage overflows are treated on the land before discharge to a stream. W71-06853

TIVERTON SEWAGE WORKS RECOGNIZES FLOOD HAZARD.

Surveyor, Vol 84, No 4028, p 30-32, Aug 15, 1969.

Descriptors: *Drainage systems, *Sewage disposal, *Sewers, Flood control, *Multiple-purpose projects, *Treatment facilities, Design criteria, Sludge treatment, Sewage treatment, Waste disposal, Waste water treatment. Identifiers: *Great Britain.

Extensive main drainage and sewage disposal schemes were completed at Tiverton, Devon. Plans involved relaying of the town's sewers, the provision and renovation of pumping stations, and the reconstruction of sewage disposal works. All three aspects of the work are fully described. Previous town sewers consisted of old brick culverts which were badly silted, and infiltration water entered in places. A complicating factor at Tiverton is that the works are susceptible to flooding from the nearby River Exe. This complication was considered in the design of the works, particularly with regard to sludge treatment. To overcome problems of drying sludge, a method of mechanical drying, called sludge pressing, was installed. A mixture of primary, humus, and stormwater sludges is passed to a chemical conditioning tank where lime and ferrous sulphate solutions are added and mixed with the sludge. The pressing, which takes about seven hours, is performed automatically. The entire procedure is outlined. W71-06855

DUAL PURPOSE SETTLEMENT TANKS AT ANDOVER.

Surveyor, Vol 83, No 4013, p 29 and 44, May 3,

Descriptors: *Sewage treatment, *Treatment facilities, Design, Sediment control, Pumping plants, Weirs, City planning, Waste water treatment. Identifiers: *Storm tank, *Storm overflows, *Great

Andover's new sewage treatment works embodies four unusual design features, namely, dual purpose primary sedimentation and stormwater tanks, double filtration, elutriation, and filter pressing. As a temporary extension, three sedimentation tanks were constructed to deal with an excess dry weather flow. The original pumping station was converted to a stormwater pumping station, and preliminary treatment units were replaced by an inlet works composed of coarse screens, a bypass channel, flow controlling weirs, and a storm overflow chamber. Flows up to 3 d.w.f. pass to the new main pumping station. Flows between 3 and 6 d.w.f. surcharge and pass to the old station converted for stormwater pumping. Flows exceeding 6 d.w.f. discharge into existing stormwater tanks. The rectangular sedimentation and stormwater tanks were combined into one unit of eight tanks, four back-to-back with a gallery between. Advantages of this system are cited. Descriptions are given of the previous facilities, effluent requirements, temporary extensions, the new main pumping station, the pumping main, the treatment works, primary and secondary treatment, final settlement, sludge digestion, elutriation and conditioning, filter pressing, and landscaping architecture.

ASHFORD (KENT) SEWAGE WORKS AFTER FOUR YEARS.

Surveyor, Vol 83, No 4000, p 38-41, Jan 31, 1969. 3 fig, 1 tab.

Descriptors: *Construction, *Design, *Operations, *Sewage disposal, *Treatment facilities, *Sewage treatment, *Controlled drainage, *Sludge treatment, *Effluents, Storm runoff, Waste water treat-

Identifiers: *Great Britain.

Major items are presented from a longer paper that described in detail the design, operation, and problems involved in construction of the Bybrook Sewage Disposal Works at Ashford in Kent. In one town served by the old Bybrook works, flows exceeding 6 d.w.f. discharged directly to the old River Stour, Old, stormatter, storage tanks. Stour. Old stormwater storage tanks, previously serving Bybrook only, were improved and a short weir constructed so that all flows pass through both weir constructed so that all flows pass through obth tanks before discharge to the river. Two auto sludge scraping mechanisms aid removal of sludge which is returned along with the tank contents by a stormwater pump to the works for full treatment. The following topics relating to the new disposal works are discussed: trade wastes, the standard of effluent, inlet works, settlement tanks and filters, humus tanks, the irrigation area, stormwater, sludge treatment, commissioning techniques, percolating filters, the digestion plant, mechanical plant problems, the pumps' insides and filter arms grounding. The paper concentrates on early operational problems, but notes that the disposal works' effluent has proven to be excellent. W71-06851

FARINGDON RDC NEW SEWAGE WORKS.

Surveyor, Vol 82, No 3980, p 54-56, Sep 13, 1968.

Descriptors: *Treatment facilities, *Sewerage, *Sewers, *Overflow, *Controlled drainage, Storm runoff, Waste water treatment.
Identifiers: *Combined sewers, *Storm sewers,

*Great Britain, Capacity.

A conventional treatment plant of modern design and large capacity, plus a new and extensive sewerage system replaced a formerly overloaded system at Faringdon in the Berkshires. Additional sewers were provided to relieve the existing system from surcharge and from extremely heavy flows from a new relief road constructed to overcome flooding. Faringdon has a combined sewerage system which must be of a size and capacity sufficient to handle the heaviest storm. The sewage disposal works and sewers leading to the works were designed to handle 3 x dwf. Provision was made for flows over 3 x dwf by constructing large diameter sewers which operate immediately when combined sewers run over. The stormwater sewers do not flow to the disposal works, but discharge onto a stormwater irrigation area. Advantages of this system over the previous one are reported. The new treatment works is described in general, in addition to the procedure used to treat storm flows over 3 x dwf. W71-06858

LAUNCHING A TWO MILE SEWAGE OUT-

For primary bibliographic entry see Field 05E.

W71-06859

NEW SEWAGE DISPOSAL WORKS FOR OAKENGATES U.D.C.

Surveyor Munic City Engrs, Vol 129, No 3920, p 31-32, 1967.

Descriptors: *Sludge treatment, *Sewage treatment, Waste water treatment.

Identifiers: *Great Britain, *Storm tank, *Biological filtration.

An illustrated description is given of a new sewage works at Oakengates, Salop., which provides complete treatment by biological filtration for up to 3 times the dry-weather-flow of 0.8 m.g.d. Primary sludge and sludge from stormwater tanks are discharged to thickening tanks, and secondary sludge is returned for treatment or pumped to the thickening tanks if required. After thickening, sludge is dewatered on beds. W71.08860 W71-06860

AWARD WINNING INDUSTRIAL WASTE TREATMENT PLANT.

Water Pollution Control, Vol 107, No 7, p 18, Jul

Descriptors: *Waste water treatment, Ponds,

Identifiers: *Stormwater pond.

Chrysler's industrial waste treatment plant handles combined storm and industrial waste water. The plant is designed to remove and dispose of free and emulsified oils, detergents, caustic strippers, and acid rinses. A stormwater holding pond of three million gallons stores excess flow from the industrial plant under storm conditions. Exceptionally long and heavy rainfalls could cause the pond to over flow; however, a sufficient detention time would still allow suspended solids to settle out. Stored stormwater is treated later when the plant sewage load has decreased. W71-06861

RECOVERY OF ZINC SULPHATE IN THE MANUFACTURE OF HIGH-TENACITY RAYON

CORD, (RUSSIAN), A. T. Serkov, I. N. Kotomina, and V. A. Kolchin. Khimica Volokna, No 5, p 30-32, 1962.

Descriptors: Waste water treatment, Evaporation, Waste treatment, Fibers (Plant), *Waste reuse. Identifiers: *Viscose rayon wastes, *Rayon tire cords, Tire yarns, Zinc compounds, *Zinc sulfate, *Waste recovery.

An economical method is given for recovering zinc by evaporation from waste waters from the producby evaporation from waste waters from the production of viscose rayon tire cord. It involves counter-current washing of the freshly-formed fibers so that a large proportion of zinc sulphate is removed from them, thus substantially reducing the concentration of zinc sulphate in the subsequent bath and hence reducing the volume of water required for its dilu-tion. The process reduces the loss of zinc sulphate to 0.03 kg per kg of fibers, the bulk of zinc sulphate recovered being returned to the spinning bath. A similar process can be applied to the recovery of zinc from effluents produced during the manufacture of other types of viscose rayon fibers. (Livengood-North Carolina State)
W71-06862

OXFORD SEWAGE TREATMENT PLANT.

Water Waste Treat, Vol 12, No 9, p 280-281, Sep/Oct 1969.

Descriptors: *Treatment facilities, *Overflow, Sewage treatment, Regulation, Waste water treat-Identifiers: Great Britain

Waste Treatment Processes—Group 5D

Extensions of the Oxford Sewage Treatment Plant were required when overloads reached 2 million gallons per day. Now all flows, after preliminary treatment, are pumped to the inlet channel where two-thirds are sent to the old works and one-third two-thirds are sent to the old works and one-third to the new works with peak flow/storm balancing tanks acting progressively above 7,000 g.p.m. The dimensions and workings of new units are described. Additions to the plant include: three peak flow/storm balancing tanks, an aeration plant unit, side wall unit extensions to the original flat bottom tanks, infinitely variable speed pumps serving the return activated sludge plant, two hopper bottom tanks, a secondary sludge digestion unit, and three tanker vehicles for conveying consolidated activated sludge. W71-06863

NEW PUMPING STATION FOR LIVERPOOL.

Water Waste Treat, Vol 12, No 9, p 297, Sep/Oct

Descriptors: *Pumping plants, *Treatment facilities, *Pumps.
Identifiers: *Great Britain, *Storm tank.

The new pumping station for Liverpool is part of a major extension program which provides further sedimentation tanks, stormwater tanks, and in-creased biological filtration capacity. The station is designed to accomodate seven vertical sewage pumps, four of which (dryweather pumps) are arranged so as to deliver sewage through one rising main to the primary sedimentation tanks. The three remaining pumps (stormwater pumps) deliver sewage through a second rising main to the stormwater tanks. The operation and output of the pumps are described. Ultraviolet lamps are used to suppress odor and retard any fungoid growth which may occur in the pump house basement. W71-06864

INSTRUMENTATION AND CONTROL AT DAL-MARNOCK SEWAGE DISPOSAL WORKS.

Water Waste Treat, Vol 12, No 1, p 19-20, May/Jun 1968.

Descriptors: *Sewage treatment, *Flow measurement, Sludge treatment, Effluents, Waste water treatment.

Identifiers: *Scotland.

The instrumentation and control provided by the Lea Recorder Co. for the new activated-sludge plant at Dalmarnock, Glasgow, are described in detail. Provision has been made for automatic sampling at various stages of treatment, as well as for the control and recording of the flows of sewage, stormwater, and effluent. The final effluent is discharged to the River Clyde. W71-06865

WATER RE-USE.

Chem Eng Program, Symposium Series, Vol 63, No 78, 1967. 284 p.

Descriptors: *Water reuse, *Water pollution control, *Waste water treatment, *Application methods, *Analytical techniques, Design, Sewers, Sewage treatment.

This publication contains the papers presented at the 59th annual meeting of the American Institute of Chemical Engineers in Detroit, Michigan, during an international conference on the conservation of waste water by reuse, and additional papers from other meetings of the Institute are also included to give broad coverage of the subject. Information on the reuse of waste water for industrial or municipal supplies is presented for 9 countries and considera-tion is also given to the role of water reuse in the prevention of pollution, management of water resources, and design of sewerage systems; medical, legal, and economic aspects; internal reuse of

water in factories; treatment for reuse, including the use of chemicals, ionizing radiation, activated carbon, and biological processes; removal of viruses, phosphates, and nitrogen compounds; reuse in spaceships; recovery of chemicals; analytical techniques; disposal of sludges; and complete reuse of all waste waters including storm sewage. W71-06866

PROBLEMS OF WATER TREATMENT IN DEVELOPING COUNTRIES,

D. Anderson. Effluent Water Treat, Vol 8, No 10, p 513-516, Oct 1968.

Descriptors: *Waste water treatment, Waste water (Pollution), Sewage, Public health. Identifiers: Developing countries.

There will be an increase in the volume of waste water and in the concentration of pollutants due to the increase in the total use of water for municipal, agricultural, and industrial purposes. The problems created by this increase include: development of water resources investigating river morphology and irrigation; sewage waste stressing the reduction of the oxygen consumable in sewage; trade waste water caused by a rapid program of industrialization; equipment and processes wherein design stan-dards used in industrial countries were also applied to developing countries, citing the installation of a treatment plant and an inadequate stormwater system; water and waste water management; and water-borne disease. Research information is needed for combatting the water treatment problems. W71-06867

EXTRACTS FROM THE ANNALS OF A SEWAGE-WORKS MANAGER, 1950-1966,

T. A. Austin.

Paper presented at a meeting of the Institute of Water Pollution Control, Birmingham, November

Descriptors: *Sewage treatment, Effluents, Water pollution, Water reuse, Investigations, Biochemical oxygen demand, Waste water treatment.

*Great Britain, Storm Suspended solids.

An historical account is given of the development of sewage works at Leamington Spa with special reference to the problems encountered. Aspects considered include: the system adopted for charging, conveying, and treating trade waste waters; raising of weirs on storm sewage overflows to over-come pollution of the River Leam; and experiments on the treatment of effluent to permit reuse for industrial purposes. The works now serve a popula-tion of 58,000 and treat an average flow of 4.5 m.g.d., with an efficiency of 93.7 per cent (based on BOD). In view of continually increasing loads, a scheme is being developed for a new works, together with a new Avon valley sewer. Trials were carried out using spray-irrigation of screened sewage on grass plots with underdrains which removed 89 per cent of the BOD and 95 per cent of the suspended solids. W71-06868

SEPARATION OF SEWAGE FROM STORM-WATER.

V. W. Bacon, R. Leland, and B. Sosewitz. In: Symposium on Storm Sewage Overflow, Inst of Civil Engrs, p 143-152, 1967.

Descriptors: *Sewers, *Water pollution sources, Storage, Design, Illinois. Identifiers: *Storm sewage, *Chicago.

In the U.S., since the conversion from existing combined sewage systems to separate systems would not be economical, various alternate methods of preventing pollution by storm sewage have been investigated. The Chicago underground storage plan followed by back-pumping to surface reservoirs for sedimentation and chlorination is discussed. W71-06869

ROTARY VIBRATORY FINE SCREENING OF COMBINED SEWER OVERFLOWS; PRIMARY TREATMENT OF STORM WATER OVERFLOW FROM COMBINED SEWERS BY HIGH-RATE, FINE-MESH SCREENS, Donald M. Marske.

In: Combined Sewer Overflow Abatement Technology. Water Pollution Control Research Series, Report 11024--06/70, p 57-106, Jun 1970. 13 fig, 6 tab, 2 ref.

Descriptors: *Sewage treatment, *Overflow, *Storm runoff, *Screens, Economic feasibility, Treatment facilities, Waste water treatment. Identifiers: *Combined sewers.

The feasibility, effectiveness, and economics of emof stormwater overflow from combined sewer systems is detailed herein. Based on final performance tests run on dry-weather sewage, the unit (63 inches high and an outside diameter of 80 inches) is capable of 99% removal of floatable and settleable solids, 34% removal of total suspended solids and 23% removal of total suspended. solids, and 27% removal of COD. The screened effluent is typically 92% of the influent flow. The esti-mated cost of treatment is 22 cents/1000 gallons for a scale-up design of a 25 mgd screening facility. It was observed that the proposed screening facility required 1/10 to 1/20 the land required by a con-ventional primary treatment plant. (See also W70-W71-06870

THE DESIGN AND CONSTRUCTION OF RE-GIONAL SEWERAGE AND SEWAGE TREAT-MENT WORKS FOR LIVINGSTON NEW TOWN INCLUDING ITS ENVIRONS AND FOR THE

NEWBRIDGE AREA, T. A. C. Brownlie, and W. Ferguson. J Inst Public Health Engrs, Vol 68, Part 3, p 160-188, Jul 1969.

Descriptors: *Sewerage, Sewage treatment, Design, Overflow, Waste water treatment. Identifiers: *Storm sewers, *Combined sewers, Treatment methods, Storm tank, Great Britain.

Described in detail are plans for Livingston New Town and its environs and Newbridge. Separate sewers were adopted for the New Town while existing combined systems were re-sewered for separation only when redevelopment took place. Overflows were suggested where major existing sewers were to be connected to newer sewers, and at least 6 d.w.f. will be passed to the new sewer. Primary tanks of the existing sewage treatment works will be converted to storm water tanks and pumps installed to convey stored sewage back to the new sewer. No flows below 18 d.w.f. should reach rivers without treatment. Surface water storm sewers will be built according to the size necessary to drain the 'once a year storm,' even though rain of this intensity and duration is not likely to occur more than once in three or five years. Descriptions are given of the size, capacity, and model of treatment and operation for the numerous parts of the sewage treatment plants proposed. No storm water settling tank is envisaged for the first development, and fu-ture expansion and increase in population will determine whether a storm settling tank is required. Partial treatment of 6 x d.w.f. or more will be possible. Capital and operating costs for both treatment plants are tables as are data concerning capacities and dimensions of each treatment mechanism. W71-06871

HYDROGEOLOGIC STUDIES ARE KEY TO SAFETY IN WASTE MANAGEMENT PRO-GRAMS,

For primary bibliographic entry see Field 05E. W71-06872

Group 5D—Waste Treatment Processes

CITY OF NORWICH SEWAGE WORKS,

P. Cotton

Water Pollution Control, Vol 67, No 4, p 454-457,

Descriptors: *Sewage treatment, *Biocontrol, *Sludge treatment, Waste water treatment. Identifiers: *Great Britain, *Biological filtration, Storm tank.

An illustrated description is given of the sewage works of Norwich, which are designed to treat a dry-weather flow of 7.5 m.g.d. by biological filtration with recirculation of effluent. Flows in excess of three times design flow are settled in storm tanks. Sludge is thickened by sedimentation before digestion and digested sludge is passed to a storage lagoon before being dried on beds, disposed of on land in liquid form, or distributed by tanker to surrounding farms. W71-06873

MICROSTRAINING OF SEWAGE EFFLUENTS

E. W. J. Diaper, and M. R. Lowndes. Effluent Water Treat, Vol 10, No 6, p 323-325, 327, 328, Jun 1970.

Descriptors: *Filtration, *Waste water treatment, *Pollution abatement, Pollutant identification, Economic justification, Standards, Legislation,

Suspended load, Chlorination, Ozone.
Identifiers: *Microstraining, Storm overflows,
Chicago, Lebanon, Ohio.

Emphasis has recently been placed on up-grading effluent standards to maintain, or improve, river quality in lieu of increasing contamination from municipal and industrial discharges. Each state must formulate standards for waste water treatment as a result of legislation introduced by the Federal Government. Increased attention has been paid to the compounds of phosphorus and nitrogen in effluents since these chemicals provide nutrients for plant life in the receiving stream. The basic operating principles of a typical microstraining installation are reviewed. The article outlines the results from three investigations in which microstraining has been assessed as an economic aid in preventing pollution in: (1) Lebanon, Ohio - where methods of removing suspended matter that tend to overload advanced waste treatment processes were explored; (2) Chicago - where the necessary tertiary treatment stage at three plants is being being determined in order to meet state standards; and (3) the Cochrane Division of the Crane Co. - where the removal of suspended solids in stormwater overflows by microstraining and the reduction of bacteria in these effluents by chlorination and ozonation are being evaluated. W71-06874

NEW APPROACHES TO WASTE WATER TREATMENT,

E. W. J. Diaper, and Russel L. Culp. J Sanit Eng Div, Am Soc Civil Engr, Vol 95, No SA 5, p 978-980.

Descriptors: *Sewage treatment, Storm runoff, Waste water treatment. Identifiers: Combined sewers, Philadelphia.

In his comments, E.W.J. Diaper mentions the fact that the combination of microstraining and ozonation for the treatment of combined sewer stormwater overflows is being evaluated in Philadelphia, Pennsylvania. W71-06875

NEW ACTIVATED SLUDGE PLANT TO SERVE THREE WARWICKSHIRE VILLAGES, Brian M. Dubleton.

Surveyor, Vol 82, No 3972, p 31-33, Jul 19, 1968. 5 fig.

Descriptors: *Sewage treatment, *Treatment facilities, *Separation techniques, Sewers, Drainage programs, Design, Overflow, Waste water treat-ment, *Activated sludge, Sludge. Identifiers: *Great Britain, Trunk sewer, Storm

The Atherston Rural District Council constructed a new sewage treatment works and installed several miles of trunk sewers to supercede three existing, overloaded works and to provide for mains drainage in two towns not previously sewered. An activated sludge plant was also proposed for construction. The partially separate sewers in most of the villages were adequate for even anticipated future flows, but in a few instances where surcharging occurred, new sewers were laid. In one area, storm overflows on the sewers were considered to reduce flow to the new works, but separation at the site of the works was found to be preferable. A complete description of the design of the new works is given. Storm tanks can hold the equivalent of 12 hours d.w.f. At times of very heavy rainfall, tanks over-flow to Penmire Brook. After a storm, contents of the tanks are returned to the pumping station to be lifted to the works for treatment. The treatment process and sludge handling are described. W71-06876

SUBMARINE PIPELINE TO DISCHARGE TREATED EFFLUENT AT SPILSBY RDC,

Nigel East.

Surveyor, Vol 85, No 4053, p 38-40, Feb 13, 1970. 10 fig.

Descriptors: *Sewage treatment, *Treatment facilities, *Separation techniques, *Steel pipes, Construction, Outlets, Storm runoff, Sewers, Sewerage, Effluents, Waste water treatment, Waste disposal. Identifiers: *Great Britain, Storm tank.

Spilsby RDC's sewerage scheme involves two sewage treatment works and construction of a 1.5 mile outfall sewer to dispose of effluent from both works. In one works, storm flows exceeding 3 d.w.f. are separated and passed to storm tanks and additional flows screened only before passing to the final effluent sump. The previous raw sewage, stormwater, and effluent pumping plant was augmented and the filter distributer arms replaced with others of greater capacity. The outlet sewer system was revised to take the effluent to the submarine outfall. Modifications of the second works provided a degree of treatment similar to that at the first works. The bitumen enamel-coated steel submarine pipeline is described in addition to methods used for trench excavation and launching.

TREATMENT OF URBAN STORMWATER RU-

NOFF, F. L. Evans, E. E. Geldreich, S. R. Weibel, and G. G. Roebeck.

J Water Pollution Control Fed, Vol 40, No 5, Res Suppl, R162-170, 1968.

*Sedimentation. Descriptors: *Chlorination, Laboratory tests, Microorganisms, Waste water treatment, Ohio, *Storm runoff, Urbanization. Identifiers: *Cincinnati, Runoff treatment.

Tabulated and graphical results are given of laboratory studies on treatment by sedimentation and chlorination of runoff from an unban area of Cincinnati which is sewered on the separate system. Plain sedimentation for less than one hour was not effective in reducing COD, BOD, concentrations of nitrogen, phosphate and solids, or the total counts of three bacterial indicators, but improved removals were obtained with sedimentation for four hours. A dose of 2-6 mg of chlorine per litre applied for 20 min was necessary to effect a 99.99 per cent kill of total coliform organisms, faecal coliform organisms, and faecal streptococci. Even with such high doses of chlorine and the presence of free residual chlorine after treatment, aftergrowth of total coliform organisms occurred in 24-72 hours; however, there was no significant aftergrowth of faecal organisms. From these results it is

suggested that the count of faecal coliform organisms rather than total coliform organisms is more realistic indicator of the downstream effects of chlorinated discharges. W71-06878

KAPPALA UNDERGROUND SEWAGE WORKS, STOCKHOLM,

Civil Eng Public Works Rev, Vol 65, No 766, p 517-520, May 1970. 4 diag, 1 map, 1 tab.

Descriptors: *Sewage disposal, *Tunnels, *Treatment facilities, Construction, Planning, Cost analysis, Infiltration, Storm runoff, Waste water treatment, Waste disposal. Identifiers: *Gravity sewer, Sweden.

Ten suburban communities north of Stockholm formed the Kappala Union to deal with their sewage problems. They planned to convey sewage to a sewage treatment plant on Lidingo Island, enabling effluent to discharge into the main stream of water. Plans are described for the establishment of a sewage of a sewage of the sewage of of a system of gravity sewer tunnels to convey waste water to the plant. The flow was intended to consist of municipal sewage and groundwater infiltechniques for the sewage tunnels and the treatment plant are discussed, as is the planning of the plant and main pumping station. Total costs for the project are given in a table.

W71-06885 tration without much stormwater. Construction

TECHNIQUES AND RECENT DEVELOPMENTS IN SEWAGE WORKS DESIGN,

R. P. Boyd James

Water Pollution Control, Vol 69, No 1, p 62-66,

Descriptors: *Sewage treatment, Sludge treatment, Evaluation, Overflow, Waste water treatment. Identifiers: *Storm tank, *Treatment processes, Storm sewage.

New techniques and developments in three different areas are discussed, the areas being: sewage treatment and its effect on operators and others, the effectiveness of sewage treatment, and the efficiency of the process. Developments in sludge dewatering and aerial nuisance decrease the unattractiveness of sewage treatment to operators and other employees. The advances and deficiencies of tertiary treatment, biological treatment, and preliminary treatment and sedimentation are presented in relation to the influences they have on the effectiveness of sewage treatment. Also in this area, the failings of storm sewage treatment are enumerated, and the author strongly recommends that provisions for storm tanks or irrigation areas be made in order to reduce pollution from overflows. He asserts that it is better to intercept a 40 d.w.f. flow in a storm tank than to give full treatment to a mere 6 d.w.f., allowing the remainder to overflow. F.W. Allen in the 'Discussion,' suggests that storm tank treatment could be improved if full use were made of the storage capacity of sewers and if one storm has no outlet to the river so that the first storm flush could be stored there and later sent back for treatment. He also recommends that overflows sited on a sewer near a trade effluent discharge be upstream of the discharge to allow the trade effluent to pass to the sewage works. New techniques in the efficiency area of sewage treatment are also described in addition to civil engineering developments that speed construction. W71-06886

SILT REMOVAL FROM COMBINED SEWERS,

D. Laredo, and E. A. Bryant. Water Sewage Works, Vol 115, No 12, p 561-564,

Descriptors: *Massachusetts, *Sewage treatment, *Chlorination, Storm runoff, Waste water treatment Silts Identifiers: *Degritting tank, Combined sewers.

Waste Treatment Processes—Group 5D

At the 50-m.g.d. primary sewage works of Fall River Mass., which is served by combined sewers, a degritting tank and facilities for preliminary additional chlorination have been installed to treat storm flows which previously had to bypass the works because they fouled the sedimentation tanks. The design, operation, and performance of the degritting tank are described. W71-06887

THE SEWAGE DISPOSAL AT VELDEN ON

LAKE WORTHER, W. Lengyel. Oesterr Wasserwirtsch (OSWAAI), Vol 20, No 9/10, p 204-210, Sep/Oct 1968.

Descriptors: *Pollution abatement, *Sewage treatment, Pumping plants, Pressure conduits, Waste

water treatment.
Identifiers: *Lake Worther, Germany, Combined sewers, Separate system.

To prevent and control polluting loads from entering Lake Worther, additional sewage works were constructed to serve the health resort of Velden. These works provide primary treatment for domestic sewage and trade waste waters in tanks and have facilities for sludge digestion and mixing of sludge and garbage. Owing to the complex geographical conditions of the area, a central pumping station had to be provided to pump the sewage via a long pressure pipe 65 m above water level to the lake. The author outlines the factors which affect the use of combined sewerage systems as compared with separate systems and discusses the advantages and disadvantages. In the case of Lake Worther the separate sewerage system is recommended, but strict control should be kept on the number of dwellings served. W71-06888

THE UNABATED GROWTH OF WATER POL-LUTION ABATEMENT ACTIVITIES,

Austin H. Montgomery, Jr. Consulting Engr, Vol 33, No 5, p 114-117, Nov 1969, 10 ref.

Descriptors: Methodology, *Pollution abatement, *Sewers, *Costs, *Separation techniques, *Engineering personnel, Water reuse, Waste water

Identifiers: *Treatment methods.

Water pollution abatement activities were given authority and direction by the Federal Water Quality Act of 1965. An estimated cost of \$48 billion is necessary for the separation of combined sanitary and storm sewers. The traditional primarysecondary treatment plants' objectives and achievements usually have been not to restore but to slow down or prevent further degradation. Lack of knowledge of the extent and means of treating pollution sources such as pesticides, acid, erosion, fertilizers, and mine drainage, is a factor in delaying the abatement program. A list of consulting engineering firms, which have been awarded research and development grants and contracts for advanced waste water treatment techniques, is given. The trend in the reuse rather than discharge of waste water is well under way, and the most widespread reuse today is that of secondary treatment effluent as a water source for industry and agriculture. A need for professional water pollution control is emphasized. W71-06889

SPECIAL OPERATIONAL RESULTS FROM OXIDATION CHANNELS,

J. Muskat.

Oesterr Abwasser-Rundschau (OERAV), Vol 12, No 1, p 3-7, 1967.

Descriptors: *Sewage treatment, Investigations, Nitrification, *Oxidation lagoons, Waste water

Identifiers: Oxidation channels.

The advantages of oxidation channels for the treatment of sewage are discussed with special reference to the satisfactory results obtained when dealing with shock loads and with rainwater. The principles of action in straight, circular, and mixed oxidation channels are outlined including the difference in the biological conditions of each plant. The importance of dilution for the biocenose in circular channels is considered as well as the factors which affect nitrification and denitrification in straight and in circular channels.

DETROIT'S METROPOLITAN WATER POLLU-TION CONTROL PROGRAM - IN ACTION. For primary bibliographic entry see Field 05G. W71-06892

DEVELOPMENTS IN STORM AND COMBINED SEWER POLLUTION CONTROL, For primary bibliographic entry see Field 05G.

W71-06893

TAHOE AND WINDHOEK: PROMISE AND PROOF OF CLEAN WATER, Frank P. Sebastian.

Paper presented at the Third Annual National Pollution Control Conference and Exposition, San Francisco, California, Apr 1-3, 1970.

Descriptors: *Sewage treatment, *Water purifica-tion, *Treatment facilities, *Water reuse, Cost analysis, Waste water treatment.

Identifiers: *Tahoe treatment plant, *Windhoek treatment plant.

Two sewage treatment plants have shown that technology does exist to meet the stringent environmental quality standards on waste water. By 1970, the Tahoe plant will have pumped one and one-half billion gallons of purified waste water into a new reservoir for water sports and irrigation; and, the Windhoek (South West Africa) sewage purifithe Windhoek (South West Africa) sewage puriti-cation plant, using a different system, will have sup-plied nearly one-third of the drinking water for a city of 30,000 people for more than a year. The paper presents illustrations, flowsheets, and cost data on the world's two most advanced waste water treatment plants.

THE REUSE OF TREATED MUNICIPAL WASTE BY THE MIDLAND DIVISION, THE DOW CHEMICAL COMPANY, E. S. Shannon, and A. Maass.

Paper presented at the Am Water Works Assoc, Annual Conference, Washington, DC, Jun 21-26,

Descriptors: *Sewage treatment, *Chlorination, *Estimated costs, Water supply, *Water reuse, Water quality, Trickling filters, Waste water treatment, Michigan, *Municipal wastes. Identifiers: *Midland (Mich).

In June 1969, the Dow Chemical Company started to take into its cooling water and fire protection system the treated sewage from the city of Midland, Michigan. The supplemental water supply will provide up to seven million gallons per day of relatively high quality water and the reservoir will provide a three million gallon fire water supply. The Midland waste water treatment system consists of primary, and two stage trickling filter secondary treatment, followed by chlorination. There is also a three million gallon reservoir, two six thousand galpiping. The total cost of the project is estimated at \$500,000. W71-06895

SEWERAGE AND SEWAGE TREATMENT. Ralph Stone.

'Sewerage and Sewage treatment: State-of-the-Art Abstracts,' J Sanit Eng Div, Am Soc Civil Engr, Vol 96, SA1, p 35-48, Feb 1970.

Descriptors: *Waste treatment, *Sewage treatment, *Abstracts, *Waste water treatment, Activated sludge, Aeration, Oxidation lagoons, Ionexchange, Operating costs.

Abstracts of 13 on-going research projects are given. The summaries consider activated sludge effluent, clarification processes, ecology in waste stabilization ponds, waste water treatment by ionexchange resins, plant operating costs, fly ash filters, waste water aeration, individual home waste treatment systems, oxygenation, sulphides, and other problems. This paper has been prepared as an activity of the Committee with significant information on waste treatment, inclusive of subjects of research and demonstration projects. W71-06897

SEWAGE-TREATMENT PLANT,

G. Talon.

Abwass, Vol 14, No 12, p 17-18, 1967.

Descriptors: *Sewage treatment, *Aeration, *Storage tanks, Equipment, Flow control, Waste water treatment. Identifiers: Compressed-air lift.

Modifications are examined in relation to preliminary aeration equipment in a sewage-treatment plant. The incoming sewage, instead of passing through a grit chamber and storm-sewage overflow, is conveyed directly to a holding tank, inside of which is a container whose upper rim is at the same height as that of the plant itself. A compressed-air lift, mounted in the holding tank above the bottom

of the tank, comprises a vertical shaft with aeration jets. This compressed-air life has a two-fold effect: it lifts the sewage into the treatment tank, and it provides primary aeration. W71-06898

SOME STRUCTURAL DESIGN CONSIDERATIONS IN OXFORD SEWAGE WORKS EXTEN-SIONS.

Surveyor, Vol 85, No 4047, p 31-34, 36, Jan 2, 1970. 7 fig.

Descriptors: *Sewage treatment, *Treatment facilities, *Structural design, *Structural engineering,

Waste water treatment. Identifiers: *Great Britain.

Extensions to the Oxford sewage purification works are discussed. The design approach to two widely differing water rataining structures, the primary settlement and storm/balancing tanks and the elevated wash water tank to the sand filtration unit, are considered in some detail. The common thread was the elimination, where possible, of complex stresses either by introducing hinges or movement joints. Shrinkage cracking is more difficult to avoid. Possible methods of reducing such cracking are discussed. The importance of efficient and continuous curing from the moment the shuttering is struck, or in the case of slabs, from the time of initial set is emphasized.

NEW CONSTRUCTION AND PLANS FOR THE TOWN DRAINAGE OF FLENSBURG.

H. Wagner.

Ber Abwassertech Ver (BABVAD), No 17, p 27-37, 1964.

Descriptors: *Design, *Drainage programs, *Sewage treatment, *Sewerage, Sludge treatment, Waste water treatment, *Overflow, Industrial wastes.

Identifiers: *Germany, Slaughterhouse wastes.

Group 5D—Waste Treatment Processes

After a brief description of existing sewage works for the town of Flensburg, the author outlines plans for expansion of the sewerage water overflow of 960 litres per sec, also receives heavily polluted waste waters from nearby slaughterhouses, increasing the five-day BOD system in this area. The plant, which at present serves a population of 90,000 with a dry-weather flow of 320 litres per sec, and a storm-to 1200 mg per litre. To reduce the heavy load, the plan includes: additional pumping stations at Galwick; the extension of the pressure pipeline to a length of 1450 m; and a treatment plant equipped for the activated-sludge process, with studge digestion followed by thickening and drying on beds, and disposal at sea by ships.

W71-06900

TREATMENT STUDIES OF COMBINED TEXTILE AND DOMESTIC WASTES,

O'Brien and Gere, Syracuse, N.Y. D. T. Lauria, and C. A. Willis.

Proceedings, Nineteenth Industrial Waste Conference, May 5-7, 1964, Purdue University, Layfayette, Ind, Part 1, p 45-58, 1964. 11 fig, 3 tab,

Descriptors: *Biochemical oxidation demand, Pilot plants, Waste water treatment, Textiles, Industrial wastes, Treatment facilities, Biological treatment, North Carolina. Identifiers: *Textile mill wastes, Valdese (NC).

Pilot plant studies were performed to evaluate a low-loading, completely mixed biological process for treatment of combined domestic and industrial wastes produced in the town of Valdese, N.C.
Results indicate that B.O.D. reductions of 90 percent can be obtained up to B.O.D. loadings of at least 2.0 pounds per day of B.O.D. applied per pound of sludge. Approximately 38 percent of the B.O.D. is oxidized and 68 percent is converted to

new growth. The sludge endogenous respiration rate is about .8 percent per day. These factors result in an oxygen requirement of 0.55 pounds per pound of removed B.O.D. and a net sludge production of 0.35 pounds of solids per pound of removed B.O.D. Becuase of an alpha factor (K sub La mixed liquor/K sub La water) of 0.5 and proposed operating conditions, aerators must be selected to transfer an equivalent of 3 pounds of oxygen to water at 20 deg and O mg/liter oxygen of each pound of oxygen required in the mixed liquor. Required settling tank loading for sludge removal is about 35 pounds per day sludge solids (dry basis) per square foot of sur-face area, and excess sludge disposal will be by cen-trifugation and landfill. Chlorine feed machines

DOW SURFPAC PILOT STUDY ON TEXTILE

must be sized for a dosage rate of 10 mg/liter. (Robinson-North Carolina State University)

Crompton-Shenandoah Co., Inc., Waynesboro, Va. Duane W. Snyder.

Proceedings, Eighteenth Industrial Waste Conference, April 30, May 1-2, 1963, Purdue University, Lafayette, Ind, p 476-482, 1964. 5 fig, 2 tab, 2 ref.

Descriptors: *Equalizing reservoirs, Waste water treatment, Textiles, Biochemical oxygen demand, *Pilot plants.

Identifiers: *Dow Surfpac (TN), *Textile mill wastes.

The optimum loading at which the BOD reduction can be maintained is 50% or better. The addition of an equalizing pond should extend BOD reduction into the 60-70 percent range, since capacity will be such as to feed the raw effluent to the treatment facility over a seven-day period. The plant is so designed that a 20 percent addition of Surfpac can be added to the tower if future demands require additional treatment. Also the equalizing basis is designed for aeration if desirable sometime in the future. The full-scale plant will include a final clarifier for removal of sludge produced in the oxidation tower. The waste is pumped from the pershall flume to a storage tank continuously, with the overflow going back into the river below the flume. The tank can also act as an equalizing stage, but the prime purpose is to act as a storage in case the sump pump becomes clogged with lint. The raw waste is pumped to the top of the tower and the overflow goes back into the storage tank. (Robinson-North Carolina State University) W71-06918

REUSE OF EFFLUENT FROM POLYESTER MANUFACTURING OPERATION,

Fiber Industries, Inc. R. S. Sahlie, and C. E. Steinmetz. Modern Textiles, Vol 50, No 11, p 21-28, 1969.

Descriptors: *Trickling filters, *Activated carbon, *Chemical wastes, Phosphates, Domestic wastes, *Water reuse, Water pollution sources, Waste water treatment.

water treatment.

Identifiers: *Algae screens, *Chromate reduction
unit, Textile millwastes, Polyester plant wastes,
Terephthalic acid compounds, Ethylene glycol,
Polymer additives, Methyl alcohol, Frinshing
agents, Ion exchange resins, Chromium compound,
Zinc compounds, Biocides, Dowtherms (TN).

The pilot plant project is to be completed in early 1970 and as of late 1969, it is still too early to draw any conclusions. A list of the various sources and kinds of waste is given. Because the wastes vary in concentration of flow, it is necessary to level out these surges in 3 series - connected equalization basins before permitting the chemical wastes to enter the treatment unit. The equalized chemical waste is then combined with the domestic sewage upon entry to the extended aeration activatedsludge system. The water discharged from the plant is of high quality and appears to lend itself to selected reuse in certain unspecified in-plant processes. The plant includes (1) a chromate reduction unit which removes heavy metals from the cooling tower blowdown, (2) a plastic media trickling filter which is installed to evaluate its efficiency in treatment of polyester wastes, (3) algae screens for the removal of all solids above 40 micron size, and (4) a carbon unit for the final polishing of the water. (Robinson-North Carolina State University) W71-06961

PILOT-PLANT STUDIES OF PROCESSING WASTES OF COTTON TEXTILES, George A. Hutton, Jr., and Samuel W. Williams, Jr.

Proceeding of the Southern Municipal and Industrial Waste Conference, North Carolina State University, Raleigh, N.C. p 31-43, Technical Press, Raleigh, N.C., 1969.

Descriptors: *Pilot plants, *Lagoons, *Aeration, *Trickling filters, Waste water treatment, Biochemical oxygen demand, Alkalinity, Detergents, Soaps.

Identifiers: *Chemical treatment, (Waste), Waste strength, Biological purification, pH, Carboxymethylcellulose, Starch, Mercerizer waste, Sodium hydroxide, Textile mill wastes, Mer-

Pilot plant studies were run to develop special waste-treatment methods to be standardized against the particular situations occurring in large cotton textile mills. It was desired to reduce both the volume and pollutional load of the waste and to make it more susceptible to biological purification. To reduce BOD, pH, alkalinity and other evidences of pollution, a pilot plant system was equipped with lagoons, aeration, chemical preparation, and tricling filters. In-plant changes were made to prepare for the reduction of the pollution load of the waste, e.g., by substituting carboxymethyl cellulose for starch sizes, detergents for soap in the cleaning and dyeing operations, and similar changes in dyes and finishing agents whenever practicable. It was concluded that the most important future installation will be a caustic recovery

unit to reduce the alkalinity of mercerizer waste. Experiments proved the cost of chemical treatment of wastes was too high when compared with biological methods. Results of the studies proved that the cost of full-scale industrial waste treatment was cut to less than one-fourth of the previous estimates. (Robinson - Work, North Carolina State University) W71-06993

CELLULOSE DECOMPOSITION OF XANTHATE AND PRECIPITATION OF HYDROCELLULOSE DURING PURIFICATION OF WASTE WATERS FROM VISCOSE MANU-FACTURE,

O. P. Sinev

Translated from Khimicheskie Volokny, No 2, 42-44 (Mar-April) 1969. Fibre Chemistry, No 2, Mar-April 180-183, 1969. 15 ref, 2 fig, 1 tab.

Descriptors: *Chemical precipitation, Alkalinity, Limes, Waste water treatment, Waste treatment, *Decomposing organic matter, Cellulose, Water purification.

Identifiers: *Viscose rayon, *Viscose plant wastes, *Cellulose xanthate, Hydrocellulose, Zinc com-

In considering the problem of purification of waste waters from the manufacture of viscose rayon, the sequence of decomposition of cellulose xanthate and precipitation of the resulting hydrocellulose must be separately considered. The former can be calculated from the known chemical composition of the cellulose xanthate, especially zinc content, and the temperature and pH of the precipitating bath. The rate of precipitation of suspended hydrocellulose is retarded by the formation of gas bubbles on the particles and this can be counteracted by agitation. When the solution is made alkaline with lime, considerably more rapid coagula-tion and precipitation takes place. (Work - North Carolina State University) W71-07012

TEXTILE EFFLUENT TREATMENT WITH FLUE GASES,

Shaw and Marvin Ltd., London (England). J. S. Franklin, K. Barnes, and A. H. Little. International Dyer, Vol 142, No 6, 427-432, 1969.

Descriptors: Alkalinity, Waste Water Treatment, Effluents, Textiles, Waste treatment, Hydrogen ion concentration, *Sewage treatment.

Identifiers: *Dyehouse wastes, *Mercerizing, Sodium hydroxide, Stack gases, *Textile mill wastes, Sulfuric acid, Caustics.

The effluent waste waters from dyeing operations can be handled satisfactorily by a local sewage treatment plant but the strongly alkaline waste water from the mercerizing operation requires neutralization. About 80 tons of sulfuric acid had been used in other operations and this reacts with the 350 tons of sodium hydroxide in 60 million gallons per year, but this was inadequate. To overcome the difficulty, after a period of experimentation, an absorption tower was built in conjunction with an oil fired boiler. The stack gases from this bubble through a packed column counter to the downward flow of spent mercerizing solution. The resulting waste water had a pH of 8.8 and the operating cost was estimated to be about 12 shillings per 1,000 gallons of effluent treated. (Work-North Carolina State University) W71-07030

SILICATE TREATMENT FOR ACID MAIN DRAINAGE PREVENTION, SILICATE AND ALUMINA/SILICA GEL TREATMENT OF COAL REFUSE FOR THE PREVENTION OF ACID MINE DRAINAGE.
Tyco Labs., Inc., Waltham, Mass.

Copy available from GPO Sup Doc as EP 2.10:14010DL1 02/71, \$1.00; microfiche from Na-

tional Technical Information Service as PB-198 427, \$0.95. EPA-WQO Report 14010DLI, February 1971. 94 p, 17 fig, 31 tab, 10 ref, 3 append. EPA-WQO Contract No: 14-12-560.

Descriptors: Waste water treatment, *Silica, *Gels, Mine drainage, Water pollution control, Weathering, Neutralization, *Acid mien water. Identifiers: *Coal refuse, *Alumina/silica gel,

Waterglass.

A treatment technique has been demonstrated on a laboratory scale which inhibits or prevents the generation of acid mine water from waste coal refuse. Three variations of the general method were considered: (1) Neutralization of the wateraccessible refuse with a dilute solution of sodium silicate (waterglass), (2) Development of a con-tinuous gel on the refuse surface structure which sealed off the entire pile from natural runoff waters, (3) Development within the pile structure of a continuous silica/aluminia gel to eliminate percolation through the refuse and minimize the effect of natural erosion of the gel structure. Comparison of the effluent water with an untreated pile shows of the effluent water with an untreated pile shows that the neutralized pile was effective for a minimum of 120 in. of equivalent rainfall in inhibiting AMD generation. The surface gel was effective for a longer period of time. The most effective treatment utilized a mixed alumina/silica gel formed within the pile at depths up to 6 in. This method was effective for more than 500 in. of equivalent rainfall, the duration of the test, and appeared to be exceptionally stable at that time. The weathering resistance of the treatment methods was evaluated by heating the gel treated refuse in the laboratory and exposing it to rain, snow, and the laboratory and exposing it to rain, snow, and freeze-thaw cycles outdoors. Extensive washings of the weathered test materials established the fact that the treatments were effective for at least 120 in. of equivalent rainfall (the duration of the test) in preventing AMD generation.

W71-07052

SECONDARY TREATMENT OF HOG WASTE IN AN ANAEROBIC STABILIZATION POND, North Dakota Water Resources Research Inst.,

Robert G. Butler.

Available from National Technical Information Service as PB-198 429, \$3.00 in paper copy, \$0.95 in microfiche. North Dakota Water Resources Research Institute Report WI-221-011-69, December, 1969, 35 p, 4 fig, 11 tab, 44 ref. OWRR Project A-010-NDAK (1).

Descriptors: *Anaerobic conditions, Biochemical oxygen demand, *Oxidation lagoons, Farm wastes, *Bacteria, Waste water treatment, *Anaerobic bacteria, Photosynthetic bacteria, Microorganisms, Chemical analysis. Identifiers: *Hog wastes.

This study relates the physical and chemical characteristics of the contents of an anaerobic stabilization lagoon to the bacteria that are responsible for the stabilization of the waste. The lagoon is fed by effluent from a settling tank that receives wastes from a hog barn. The lagoon operated as an unheated digester and maintained a pH between 7.2 and 8.1. The Redox potential varied from -370 to -403 millivolts. The mean concentration of volatile acids was 403 mg/l. The average level of BOD for the lagoon water was 566 mg/l. A BOD loading of 3,250 pounds per acre per day did not produce lagoon failure. Sulfate reducers were grown on Postgate's Media E. Methane producing organisms were detected. Photosynthetic organisms were detected. Photosynthetic organisms were more to two different media. isms were grown on two different media. W71-07055

5E. Ultimate Disposal of Wastes

THAT ENVIRONMENTAL QUESTIONS NOBODY LIKES TO HEAR. For primary bibliographic entry see Field 05G.

MEMORANDUM OF EVIDENCE TO THE MINISTRY OF HOUSING AND LOCAL MINISTRY OF GOVERNMENT WORKING PARTY SEWAGE DISPOSAL.

Committee from the Inst. of Water Pollution Con-

Water Pollution Control, Vol 68, No 6, p 603-609,

Descriptors: *Water pollution control, *Sewage disposal, *Deterioration, *Sewage treatment, *Treatment facilities, Planning, Storm runoff. Identifiers: *Separate system, Storm sewage, Great

The Institute of Water Pollution Control gives evidence on and makes suggestions relating to sewage disposal for a Memorandum to the 'Jeger' Working Party. Topics discussed are divided into five categories: (1) public health, (2) amenity, (3) economic effects, (4) sewage treatment and disposal processes, and (5) administration and standards. Under the section on amenity, the Institute notes that with regard to the amenities of rivers, the major cause of deterioration is the generally inadequate provision for sewage disposal integral with residential and industrial expansion. Even where adequate sewage treatment facilities exist, storm-sewage discharges often impair river amenities. Separate sewer construction is recommended. Methods of sewage treatment are discussed such as: sewage sludge utilization after heated digestion, plus quaternary processes for denitrification, de-salination, and phosphate removal. Other topics covered are: trade effluent control, planning authorities, coastal pollution, settling tank design, and research. W71-06636 suggestions for investigational

GEOLOGIC AND HYDROLOGIC FACTORS BEARING ON SUBSURFACE STORAGE OF LIQUID WASTES IN MARYLAND,

Geological Survey, Parkville, Md. Edmond G. Otton.

Report available from Maryland Geological Survey, Latrobe Hall, Johns Hopkins University, Baltimore, Md. 21218, \$2.75. Maryland Geological Survey Report of Investigations No 14, 1970. 39 p,

Descriptors: *Waste disposal, *Liquid wastes, *Waste storage, *Injection wells, *Maryland, Sub-Aquifer characteristics, Water quality, Hydrologic properties, Evaluation, Planning. Identifiers: *Subsurface liquid-waste storage,

*Waste injection wells.

Maryland is divided into 3 major regions and these, in turn are divided into 8 major subregions on the basis of physiography, geology, and hydrology and each is discussed in relation to deep-well injection of wastes. In the Appalachian Region, there are several porous zones that might accept injected wastes, and thick sequences of low-permeability rocks might function as confining layers. In some places there are fresh-water zones that must be considered and in the eastern part of the Western Maryland subregion, there is extensive faulting that might permit vertical leakage of injected wastes. In the Piedmont Region the highly metamorphosed and fractured rocks of the Catoctin Mountain belt offer few opportunities for practicable injection of wastes because of the low permeability and generally ineffective confining layers. In the Coastal Plain Region factors related to waste injection decisions range widely. Most of the aquifers contain fresh water in the Inner Coastal Plain and the number decreases seaward. In the Middle Coastal Plain, there appear to be several saline aquifers below a depth of about 2,000 feet and in the Outer Coastal Plain there are many. Throughout the Coastal Plain Region there are extensive thick confining layers. (Woodard-USGS) W71-06695

WASTE DISPOSAL--WATER TREATMENT PLANTS (JOINT DISCUSSION).

J Am Water Works Assoc, Vol 58, No 9, p 1102-

Descriptors: *Waste water treatment, *Waste disposal, *Sludge disposal, *Application methods. Identifiers: *Detroit, Michigan, Back-wash water.

In a joint discussion at the annual conference of the AWWA in May 1966 several speakers discussed various aspects of the problem of disposing of wastes from water treatment plants without causing pollution. Local factors were taken into account when deciding whether or not such wastes were likely to have an adverse effect on the receiving water. The effects of Pennsylvania state water quality standards and of federal pollution-control legislation on the disposal of wastes from water works were considered, and the methods of disposal at Detroit, Michigan, were described by G.J. Remus. One of the Detroit works is situated on the banks of the Detroit river and the filter washwater from this plant is discharged directly to the river; since the flow is rapid, the wash-water is dispersed rapidly and there is no evidence of sludge deposits. The wash-water is chlorinated before discharge and is bacteriologically of better quality than the river water. The other three water works are situated away from the river; at the largest of these the filter back-wash water is recirculated for reuse, while at the other two it is discharged to a sanitary sewer, and settled before discharge to a storm sewer, respectively. The sludges from the sedimentation tanks at all the plants are discharged to the sanitary sewers. W71-06846

10,000 FT LONG SEA OUTFALL AT HASTINGS IN SUSSEX.

Civil Eng Public Works Rev, Vol 63, No 746, p 1003, Sep 1968.

Descriptors: *Outlets, *Pumping plants, Pollution abatement, Pretreatment (Water), Construction, Sewage disposal, Waste disposal, Identifiers: *Great Britain, Stormwater sump.

A new sewage disposal scheme is under construction to eliminate seashore pollution caused by direct discharges to the ocean through two conventional outfalls. The plan involves pretreatment of sewage after which it is pumped through a long outfall pipe to a point two miles offshore. The pumping station will handle sewage flows up to 6 dwf or 7.5 mgd, and a combination storm weir and automatic penstock will pass excesses to the stormwater pump. A culvert will connect the stormwater sump to the foreshore, and for sea-levels below mid-tide the stormwater will discharge to the sea by gravity. At other times when the culvert is tide-locked, a stormwater pump will operate. Descriptions of physical characteristics, workings, and methods of construction of the long sea outfall and the pumping station are included along with a diagram of the new sewerage scheme. W71-06848

LOWESTOFT CHOOSES TUNNEL FOR SEWAGE OUTFALL.

For primary bibliographic entry see Field 08A.

TIVERTON SEWAGE WORKS RECOGNIZES FLOOD HAZARD.

For primary bibliographic entry see Field 05D. W71-06855

LAUNCHING A TWO MILE SEWAGE OUT-

Surveyor, Vol 82, No 3978, p 16-17, Aug 30, 1968. 4 fig.

Group 5E-Ultimate Disposal of Wastes

Descriptors: *Drainage systems, *Treatment facilities, Outlets, Water pollution sources, Construction, Pumping plants, Weirs, Storm runoff, Flow control, Costs, Design data, Waste disposal. Identifiers: *Great Britain.

The Hastings western area main drainage scheme includes a sewerage outfall, two new pumping stations, a partial treatment works, and a pumping main. The scheme was designed to replace two conventional outfalls which caused pollution of the foreshore and shallow water because of insufficient length. The new outfall was built up into seven strings in a special assembly area, and these sections were joined successively before the entire pipe was launched into its final position on the sea bed. Further construction procedures are explained along with the means used to determine the proper length of the outfall. The new pumping station pumps sea sewage flows up to 6 d.w.f., and a discharge to a stormwater sump. The sump connects to the foreshore by a culvert and for sea levels below mid-tide, stormwater discharges to sea by gravity. At times when the culvert is tide-locked, a stormwater pump operates. Costs, dimensions, and other details of the entire scheme are included in the article

HYDROGEOLOGIC STUDIES ARE KEY TO SAFETY IN WASTE MANAGEMENT PRO-GRAMS.

Robert E. Bergstrom. Water Sewage Works, Vol 116, No 4, p 149-155, Apr 1969. 7 fig, 7 ref.

Descriptors: *Groundwater, *Waste disposal, *Water pollution, *Illinois, *Treatment facilities, *Water pollution, *Illinois, *I reatment facilities, *Tunnels, Flow control, Aquifers, Data collections, *Hydrogeology, Waste water treatment. Identifiers: *Disposal operations, *Storm tunnels, *Waste management, Deep tunnel plan, Chicago.

Waste disposal is explored as a possible factor in groundwater contamination. disposal operations in Illinois that are specifically discussed include: landfills and dumps, radioactive waste burial grounds, sewage treatment and waste storage ponds, disposal wells, and sewage-stormwater tunnels. The Chicago Sanitary District's tunnel plan for the prevention of stormwater and raw sewage bypassing treatment plants and polluting streams is described. Initial reports concluded that stormwater and sewage would not pollute the groundwater reservoir because the rock in which the tunnel was bored is tight, and head relations provide that water only moves into and not out of the tunnel. Possible problems created by this project are mentioned. The following suggestions are proposed to aid groundwater practitioners in waste management: (1) the selection of sites for waste disposal based on hydrogeologic conditions which indicate natural safeguards and the protection of health and resources; (2) procurement of data needed to develop criteria for determining geologic conditions and beneficial engineering practices; and (3) the study of investigations relating to waste management topics such as saturation and water movement in typical geologic terrains that might be used for waste disposal. W71-06872

SUBMARINE PIPELINE TO DISCHARGE TREATED EFFLUENT AT SPILSBY RDC, For primary bibliographic entry see Field 05D. W71-06877

THE WATER-SEWAGE CYCLE, For primary bibliographic entry see Field 05G.

KAPPALA UNDERGROUND SEWAGE WORKS. STOCKHOLM,

For primary bibliographic entry see Field 05D. W71-06885

HYDRAULIC FRACTURING, For primary bibliographic entry see Field 08B. W71-06950

DEEP TUNNEL STORAGE MAY SOLVE CITY STORM WATER PROBLEM.

For primary bibliographic entry see Field 05G.

LABORATORY STUDY OF THE BEHAVIOR OF A SANITARY LANDFILL, Drexel Univ., Philadelphia, Pa. For primary bibliographic entry see Field 05B.

5F. Water Treatment and **Quality Alteration**

ELECTRODIALYSIS WATER TREATMENT,

Strategic Air Command, Offutt AFB, Nebr. Wilbur B. Ruebsamen.

The Military Engineer, Vol 63, No 411, p 34-36, January-February, 1971. 3 p, 6 fig, 2 tab.

Descriptors: *Water treatment, *Water supply, *Groundwater, *Electrodialysis, *North Dakota, Military reservations, Reverse osmosis, Methodology, Evaluation, Salinity, Costs.

Two methods of treatment of groundwater supply at Grand Forks Air Force Base, N.D. are described and evaluated. Electrodialysis is a process using and evaluated. Electrodialysis is a process using electrodes and semipermeable membranes that permit the passage of either cations or anions. Reverse osmosis is a process using high pressure and a semipermeable membrane. The decision of which unit to use was based on its production performance. The test and failure data show the electrodialysis unit to be superior in performance and reliability. Through use of the electrodialysis water treatment system, the money saved from the main-tenance of the old distillation process has paid for the purchase, installation, and operational cost. It is highly reliable, aids in extending the life of other water-using equipment, and is easy to operate and maintain. (Woodard-USGS) W71-06660

ENVIRONMENTAL HEALTH AND COMMUNI-TY PLANNING,

J. A. Salvato, Jr.

J Urban Planning Devel Div, Am Soc Civil Engrs, Vol 94, No UPI, p 23-30, Aug 1968.

Descriptors: *Planning, *Environmental effects, Public health, Urbanization.

Effects are given of a type of planning which includes land use, water system and transportation, and prevention of problems caused. The health department responsibility for the issuance of permits and approval of operational results to protect public health is emphasized. W71-06754

ANALYTICAL PROCEDURES FOR MEASUR-ING CHEMICALS IN THE PUBLIC HEALTH SERVICE DRINKING WATER STANDARDS, 1962,

Norman A. Clarke, and John D. Weeks J Amer Water Works Assoc, Vol 62, No 3, p 172-176, Mar 1970.

Descriptors: *Standards, *Potable water, *Analytical techniques, *Measurement, *Chemical analysis, Pollutant identification.

A list is compiled of chemical substances in the Drinking Water Standards, and recommended methods of analysis and sensitivity of techniques for measuring these chemicals are defined. Also included are the methods of atomic absorption and spark emission spectroscopy, where applicable. W71-06765

ARCTIC ENVIRONMENTAL TEST OF WATER HANDLING, WATER STORAGE, AND WATER PURIFICATION EQUIPMENT.
Army Test and Evaluation Command, Aberdeen

Proving Ground, Md.

Available from NTIS as AD-867 022, \$3.00 in paper copy, \$0.95 in microfiche. Report MTP 8-4-014, Nov 1969. 10 p, 8 ref.

Identifiers: *Water supplies, Test methods, Arctic regions, Handling, Storage, Army research, Transportation, Acceptability, Safety, *Water storage, *Water treatment.

The environmental test procedure describes test methods and techniques for evaluating the performance and characteristics of water handling, water storage, and water purification equipment under arctic winter conditions. W71-06793

WATER AND SEWERAGE FACILITIES PLANNING PROGRAM FOR MADISON, ST. CLAIR AND MONROE COUNTIES, ILLINOIS.

PHASE I-PROGRAM DESIGN.
Southwestern Illinois Metropolitan Area Planning Commission, Collinsville.

For primary bibliographic entry see Field 06B. W71-06794

HEALTH PROBLEMS.

Wisconsin Univ., Madison. Dept. of Bacteriology. For primary bibliographic entry see Field 05G. W71-06813

PROBLEMS OF WATER TREATMENT IN **DEVELOPING COUNTRIES,**

For primary bibliographic entry see Field 05D.

MANUAL OF INDIVIDUAL WATER SUPPLY SYSTEMS.

Department of Health, Education, and Welfare, Washington, D.C.; and Public Health Service, Washington, D.C.

Public Health Service Publication No 24 (1963 Revision). Washington, DC, US Government Printing Office, 1963. 121 p.

Descriptors: *Water quality control, Surface water, Groundwater, Water supply, *Water wells, Drilling, Pumps, Water treatment, Water condi-

Identifiers: *Sanitary protection of wells, *Water well construction, Bacteriological quality, Emergency disinfection, Suggested ordinance, Contamination sources.

Developed in cooperation with the Joint Committee on Rural Sanitation, this manual reflects the changing trends in the problems of individual water supply systems and includes additional and new information in this field which has come to the attention of the Public Health Service. While establishing uniform practice among various Federal Agencies concerned with the sanitation aspects of individual water supplies, the manual would also be of use to state and local health authorities, welldrillers, industry groups, and others concerned with the development and operation of such supplies. It emphasizes the sanitation aspects of small supply systems such as those servicing individual dwellings, farms, rural schools or similar institutions, recreational or tourist accommodations. camps, or other installations not having access to public water supply systems. The recommended practices should be helpful in the design, construction and operation of these types of private and quasi-public systems. (Campbell-NWWA) W71-06959

Water Quality Control—Group 5G

5G. Water Ouality Control

AN OIL DISPERSANT'S EFFECT ON THE MICROFLORA OF BEACH SAND. Washington Univ., Seattle, Wash, Dept. of Zoolo-

For primary bibliographic entry see Field 05C.

W71-06491

LEGAL ASPECTS OF WATER SUPPLY AND WATER QUALITY STORAGE,

Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center

William R. Walker, and William E. Cox.
Bulletin No 37, Water Resources Research Center,

Virginia Polytechnic Institute, Blacksburg, Va, August 1970. 235 p, 19 map, 514 ref, 6 append.

Descriptors: *Watershed Protect and Flood Prev Act, *Federal Power Act, *Water supply, *Water Act, *Federal Power Act, *Water supply, *Water storage, Prior appropriation, Riparian rights, Riparian waters, Reasonable use, Relative rights, Administrative agencies, State governments, Beneficial use, Civil law, Municipal water, Federal government, United States, Legislation, Water quality, Water quality control, Water resources development, Cities, Water pollution, Consumptive use, Waste dilution.

The two main objectives of this work are: (1) to investigate the enabling legislation for federal water supply storage and the consequences of storage in federal reservoirs, and (2) to explore the impact of state water law upon federal legislation. There are four federal acts discussed: (1) the Water Supply Act of 1958; (2) the Watershed Protection and Flood Prevention Act; (3) the Federal Water Power Act; and (4) the Flood Control Act of 1944. The functions of the Bureau of Reclamation and the Army Corps of Engineers are discussed in connection with the Water Supply Act. The riparian water right is examined vis-a-vis the appropriative water right. This effort includes analysis of: (1) waters subject to each right, (2) municipal water rights, (3) the right to store water under each doctrine, (4) water supply storage, and (5) the reasonable and beneficial use concepts. The authors also explore the enabling legislation for federal water quality storage, including the 1961 amendment to the Federal Water Pollution Control Act, and storage by federal agencies. The final topic examined is the impact of state water laws on the effectiveness of water quality storage legislation. (See also W71-00480) (Hart-Florida) W71-06506

RACE TO PLUG BURST MAIN BEFORE RAINS CAME.

For primary bibliographic entry see Field 08B. W71-06543

DROP INLET REPAIRS STORMS DAMAGE TO SEWER SYSTEM.

Eng Contract Record, Vol 82, No 2, p 26, Feb

Descriptors: *Damages, *Repairing, *Intakes, *Construction materials, *Sewers, *Construction

Identifiers: *Storm sewers, *Medary, Wisconsin.

In Medary, Wisconsin, a storm sewer, washed out by heavy rainfall, was repaired in twelve days. The Wisconsin Culvert Co. recommended that the now exposed area, which had previously held a 750 foot-long piece of a 72 inch diameter storm sewer pipe, be contained by fabricating a 96 inch diameter drop inlet constructed of 8-gage corrugated galvanized steel, closely riveted and caulked. The drop inlet would connect to the existing 72 inch line by means of a watertight 84 inch diameter, 8gage galvanized steel pipe, close riveted and caulked, outlet connected at the base of the drop inlet would run 400 feet along the gouged ditch line. The method was approved and immediate

fabrication of sections of the drop inlet began followed by trucking of these sections to the site and their installation. W71-06544

WISCONSIN SANITARY SEWER WON BY

Eng News-Record, Vol 182, No 14, p 43, Apr 3, 1969. 1 tab.

Descriptors: *Costs, *Bids, Construction materials. Drainage systems. Identifiers: *Storm sewers, West Allis, Wisconsin.

Unit prices and quantities of materials proposed for a 3-branch storm sewer contract in West Allis, Wisconsin are tabulated and discussed for the two lowest bidders for each branch. Branch A includes three reinforced concrete storm tunnels and a corrugated metal culvert arch. Branch B and C will relieve severe flooding conditions in this area of W71-06545

CHICAGO SEWER DRAIN PROJECT.

Eng News-Record, Vol 182, No 10, p 41, Mar 6, 1969. 1 tab.

Descriptors: *Contracts, Drainage systems, Flood control, Concrete construction, Cost comparisons. Identifiers: *Chicago, *Sewer relieving.

Detailed statistics are given concerning bids for a contract to construct sewer drains extending the sewer system in a section of Chicago. Consolidated Construction Co., Inc. won this contract, and it will undertake the project to provide flood relief from a storm of five frequency or less. Inadequate smaller sewers will be replaced, and a number of trunk sewers and siphons will be relieved. The project will be constructed in open cut, and reinforced concrete will be the principal material used. Prices from the two lowest bidders are tabulated for each of the items to be included in the project. W71-06546

MICHIGAN SEWER AND ROAD JOB.

Eng News-Record, Vol 182, No 9, p 43, Feb 27, 1969. 1 tab.

Descriptors: *Bids, Construction materials, Concrete pipes, Backfill.
Identifiers: *Port Huron, Michigan, *Storm sewers.

Unit prices and quantities of materials proposed for a Port Huron, Michigan paving, storm sewer, and water main contract are tabulated and described for the two lowest bidders. Reinforced concrete will be used for storm sewer piping. The contractor will excavate and backfill over existing sewers because of the formerly poor backfill. W71-06547

STORM SEWER CHANNEL IN NEBRASKA.

Eng News-Record, Vol 181, No 2, p 69, Jul 11, 1968, 1 tab.

Descriptors: *Construction costs, *Bids, Concrete

Identifiers: *Omaha, Nebraska, *Storm sewers.

Bids for constructing a channel section of a storm sewer in Omaha are compared, and prices for quantities of materials are tabulated for the two lowest bidders. A long riprapped, flat-bottom ditch will be filled with reinforced concrete piping. The proposed length of the channel was shortened due to difficulties in obtaining easements. The project will improve alignment and flow capacity to prevent property damage by erosion. W71-06548

ADDITIONAL INFORMATION-FAILURE OF STORM SEWER SYSTEM.

Water Sewage Works, Vol 117, No 6, p 191, Jun

Descriptors: *Sewers, *Decision making, Overflow, Wisconsin.
Identifiers: *Storm sewers, *Medary (Wisc).

A description of the storm sewer system situation in Medary, Wisconsin prior to the overflow in June 1968 is given. The article states that the failure of the sewer line in Medary was not due to the design of the storm sewer system, the installation of the pipe, or the type of pipe used. Two reasons are given as to the cause of the overflow: modifications to the storm sewer without informing the consultant engineer; and, lack of knowledge or consideration of hydraulic principles. W71-06549

RX FOR

Water Sewage Works, Vol 116, No 12, p 464-465, Dec 1969.

Descriptors: *Construction materials, *Sewers, Storm runoff, Steel, Wisconsin. Identifiers: *Storm sewers, *Medary (Wisc).

Failure of a concrete storm sewer system in Medary, Wisconsin during a heavy rainfall resulted in property damage and threatened disaster for two major arterial highways. With weather forecasts predicting more storms, officials ordered the construction and installation of a large corrugated, gal-vanized steel storm sewer. Dimensions and details are given of the system which was installed and operating in 12 days--an unlikely feat to perform using other conduit materials. W71-06550

SEWERAGE.

British Standards Inst., London (England). For primary bibliographic entry see Field 08B. w7i-06552

MODEL STUDIES OF STORM SEWER DROP

For primary bibliographic entry see Field 08B. W71-06553

UNDERWATER INSPECTION--SEEING REVEALING.

Tom Dave

Water Pollution Control, Vol 107, No 11, p 16-17 and 31, Nov 1969.

Descriptors: *Outlets, *Storm runoff, Sewage ef-Identifiers: *Storm sewers, Toronto.

On one underwater diving job, two consulting engineers inspected storm water outfalls near the lakeshore in Toronto. They were lowered into manholes, and inside they found accumulations of silt and domestic and industrial sewage debris even though these wer storm sewers. As a result of these obstructions, storm flow had become more restricted over the years. W71-06555

URBAN RENEWAL IN WHITE PLAINS, NEW YORK.

For primary bibliographic entry see Field 08A. W71-06556

POLLUTION ABATEMENT THROUGH SEWER SYSTEM CONTROL,

For primary bibliographic entry see Field 05D.

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SOME ASPECTS OF DEEP SEWER MAIN-TENANCE,

For primary bibliographic entry see Field 08B. w71-06558

ORGANIZING AND PLANNING FOR SEWER MAINTENANCE,

For primary bibliographic entry see Field 08C.

STORM DRAINAGE PRACTICES OF THIRTY-TWO CITIES.

For primary bibliographic entry see Field 08B. W71-06560

RATIONAL 'RATIONAL' METHOD OF STORM DRAINAGE DESIGN,

For primary bibliographic entry see Field 08B.

DUNFERMLINE PAST, PRESENT AND FU-

TURE, William G. Stephenson. J Inst Munic Engrs, Vol 96, p 53-60, Feb 1969.

Descriptors: *City planning, Drainage programs. Identifiers: *Dunfermline, Scotland, *Sto *Storm sewers, Combined sewers.

The highways, drainage works, water supply, and lighting of Dunfermline are discussed. The overloading of combined sewers since the last war has necessitated extension of storm relief sewers. Two projects will begin to ameliorate the situation. Meanwhile, all new drainage projects have been laid on the separation system. W71-06562

OHIO STORMS BURST TWO RESERVOIRS.

Eng News-Record, Vol 183, No 3, p 13, Jul 17,

Descriptors: *Ohio, *Damages, Storm runoff, Storm drains.

Identifiers: *Storm overflows, Storm sewage.

Severe storms in northern Ohio caused serious damage to 23 counties in the state. In four sections of Bellevue, the heavy rains raised the water table so high that sewage-filled water rose out from the limestone channels of the underground storm drainage system. Residents spent days pumping water off to ditches draining Lake Erie. The flooding also destroyed much of Bellevue's \$4.5-million sewage interceptor and treatment plant in addition to damaging reservoirs, bridges, etc. in other Ohio areas. W71-06563

OHIO RIVER VALLEY WATER SANITATION COMMISSION: SEVENTEENTH, EIGHTEENTH, NINETEENTH, AND TWEN-TIETH YEARBOOKS.

28 p, 1965; 44 p, 1966; 40 p, 1967; 44 p, 1968.

Descriptors: *Water quality, *Control structures, *Ohio River, *Water management (Applied), Monitoring, Geological surveys, Hydroelectric plants

Identifiers: *Water quality criteria, Hydrological

Progress in cooperative work on the management of water quality in the Ohio River valley is reviewed. The 18th yearbook contains the criteria which have been recommended for water quality. Since the Water Quality Act of 1965 required the establishment of water quality standards for the individual states, a major problem is the reconciliation of standards, especially where different standards are applied to the same stretch of river bor-

dering two states. Other projects include: expansion of the system for monitoring water quality, appraising river conditions, and forecasting impending changes some days in advance; development of automated forecasting procedures for management of water quality using a mathematical model; geological and hydrological surveys to determine the potentialities and limitations of deep wells for the disposal of difficult or toxic waste waters; assessment of changes in aquatic life; and, investiga-tions on the enrichment of oxygen in rivers by vari-ous methods of operation at hydroelectric power facilities. Each yearbook includes data on the in-dividual water quality characteristics in the Ohio River and its tributaries, and on the present status of municipal and industrial pollution control facilities. The 20th yearbook also contains an article by R. H. Leach, reviewing the accomplishments of the Commission during the 20 years since its establishment. W71-06564

SEWER MAINTENANCE IN A COLD CLI-

MATE, F. E. Ayers. Journal Water Pollution Control Federation, Vol 41, No 3, p 418-423, Mar 1969.

Descriptors: *Runoff, *Hydrology, *Water pollution sources, Storms, Infiltration.
Identifiers: *Sewer maintenance, *Canada, Comhined sewers.

Sewer maintenance problems in Ottawa include threatened explosions due to improper sewer ventilation during snow and sleet storms, the entrance of granular street materials into catch basins and then the sewer systems, and the handling of excess runoff during spring thaws. The problem caused by the entrance of sand and peastone traction materials into the sewer system is greatest in the city's combined sewer district where pipes are older and laid on flatter grades than those of the newer separate system. Means of combating Ottawa's sewer maintenance problems are discussed. Two programs adopted are the crash maintenance program during spring to remove grit in flat sewers, thus allowing sewers maximum capacity for spring runoff; and the development of detained sewer maintenance records which are made available to crews handling sewer problems. W71-06565

URBAN PLANNING ASPECTS, OF WATER POLLUTION, Sigurd Grava

New York, Columbia University Press, 1969, 232

Descriptors: *City planning, *Water quality control, *Urban renewal, *Urbanization, Water pollution control.

This study, strictly limited to water-borne wastes and water quality control, represents a synthesis of experience and thought on water pollution as it applies to urban planning and is intended as a guide and source of information for urban planners and community decision makers. Although non-technical in nature, the work includes data, financial and administrative considerations, and reference material. W71-06567

DYNAMIC MODELING OF STREAM QUALITY BY INVARIANT IMBEDDING,

Kansas State Univ., Manhattan. Dept. of Industrial

Engineering. E. Stanley Lee, and Irving K. Hwang. Water Resources Bulletin, Vol 7, No 1, p 102-114, February 1971, 13 p, 11 fig, 7 ref.

Descriptors: *Digital computers, *Mathematical modeling, *Dynamics, *Estimating equations, *Water quality, *Stream improvement, Pollution abatement, Biochemical oxygen demand, Dissolved oxygen, Least squares method.

Identifiers: *Invariant imbedding.

Recently developed estimation and nonlinear filter-ing techniques for the modeling of water quality were introduced. The invariant imbedding concept was used to obtain some useful estimator equations was used to obtain some useful each to the differential equation models. By using these equations, the parameters were estimated directly from differential equations representing the pollution model and from measured noisy data such as BOD and DO. A sequential estimation scheme was obtained whereby only current data were needed to estimate the current or future values of the unknown parameters. Consequently a large amount of computer time and computer memory could be saved and formed an effective on-line-up-dating scheme for the computer modeling and control. Not only the parameters but also concentrations of pollutants could be estimated and therefore formed pollutants could be estimated an interest an effective forecasting technique. The classical least squares criteria were employed to obtain optimal estimates. To illustrate the approach a simple representation of stream quality, proposed by Camp and Dobbins, was shown. The estimation problem was represented by two equations and was solved by the invariant imbedding estimator equations. First the differential equations were integrated by the Runge-Kutta integration scheme and then the results were corrupted with noise. A more general problem was also solved to illustrate the technique. Although a digital computer was used in this work, analog computers could also be used. (Kriss-Cornell) W71-06587

HYDROLOGICAL AND ENVIRONMENTAL CONTROLS ON WATER MANAGEMENT IN AN ARID URBAN AREA, Arizona Water Resources Research Center, Tuc-

For primary bibliographic entry see Field 04C. W71-06597

WATER AND RELATED LAND RESOURCES - STATE ADMINISTRATION, LEGISLATIVE PROCESS AND POLICIES IN MINNESOTA, 1970.

Minnesota Univ., Minneapolis. For primary bibliographic entry see Field 06E. W71-06599

ENVIRONMENTAL LAW HANDBOOK,

J. Brecher, and M. Nestle.

California Continuing Education of the Bar, Berkeley, Calif, 1970. 343 p, 2 fig, 1 dwg, 3 tab, 1 chart, 523 ref, 3 append.

Descriptors: *California, *Environmental sanitation, *Environment, *Water pollution control, Adjudication procedure, Ecology, Environmental effects, Environmental engineering, Highway effects, State governments, Federal government, Administrative agencies, Legislation, Legal aspects, Water pollution effects, Water pollution treatment, Water pollution sources, Water pollution, Highways.

Evaluated in this book are the following areas: (1) environmental quality; (2) reconstructing the environment; (3) the role of the lawyer in environmental improvement; (4) litigation; (5) administrative proceedings; (6) air pollution; (7) water pollution; (8) open space; (9) other environmental issues, including noise, highways, and hydroelectric power. The author discusses the causes of environmental deterioration, specific crisis areas, and long range deterioration. The following areas are considered with respect to the reconstruction of the environment: (1) the need for reform (2) economic measures, (3) new technology, (4) changes in regulatory authority, and (5) changes in business and industry. The role of the lawyer is examined in environmental advocacy, drafting legislation, and as governmental attorneys. Various procedures, causes of action, and the National En vironmental Policy Act are considered with respect to environmental litigation. A discussion of administrative agencies, hearings, and judicial review

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is included. The problems of air and water pollution, governmental regulation, and methods of con-trol are evaluated. A chapter deals with preserving privately held open space and public lands. The study concludes with appendices presenting the texts of: (1) the National Environmental Policy Act; (2) interim guidelines for Federal agencies under the Act; (3) Michigan Act No. 127; and (4) a table of federal and state environmental statutes and regulations. (Robinson-Florida) W71-06600

PUBLIC LAND POLICY AND THE ENVIRON-MENT, VOLUME 3, PART II: ENVIRONMEN-TAL PROBLEMS ON THE PUBLIC LANDS. CASE STUDIES 9 THROUGH 17, Rocky Mountain Center on Environment, Denver,

Colo.

For primary bibliographic entry see Field 06E. W71-06601

THE HUDSON RIVER BASIN.

For primary bibliographic entry see Field 06E. W71-06602

PROTECTION AND ENHANCEMENT OF ENVIRONMENTAL QUALITY.

For primary bibliographic entry see Field 06E. W71-06604

CASTING GARBAGE, ETC, INTO WATERS (CRIMINAL PENALTIES).

For primary bibliographic entry see Field 06E. W71-06612

SANITARY AUTHORITY, AND POWERS).
For primary bibliographic entry see Field 06E.
W71-06613 DISTRICTS (CREATION,

UTILITIES--ANTI-POLLUTION REQUIREMENTS.

For primary bibliographic entry see Field 06E.

WATER QUALITY STANDARDS (INTERSTATE WATERS OF IOWA).

For primary bibliographic entry see Field 06E. W71-06616

CONSERVATION COMMISSIONS IN MAS-CONNERVATION COMMISSIONS IN MASSACHUSETTS: WITH A SUPPLEMENTARY
REPORT ON THE EMERGENCE OF CONSERVATION COMMISSIONS IN SIX OTHER
NORTHEAST STATES,
Conservation Foundation, Wash., D.C.; and New
England Conservation Services Center, Lincoln,

Mass

For primary bibliographic entry see Field 06E. W71-06624

ARCTIC HEATED PIPE WATER AND WASTE

WATER SYSTEMS, J. W. Grainge. Water Res, Vol 3, No 1, p 47-81, Jan 1969.

Descriptors: *Sanitary engineering, *Sewerage,

Pipes. Identifiers: *Canada.

Sanitation problems of communities in Northern Canada are discussed, and some environmental conditions are evaluated. Improvements in sanitation in small Canadian communities by providing piped water and sewage services have been proposed. Two original, relatively inexpensive, all-weather systems suitable where pipes may not be buried on account of soil conditions are described. Ideas and suggestions for planning water and sewerage systems are given. W71-06625

ENVIRONMENTAL **QUESTIONS** THAT NOBODY LIKES TO HEAR

Am City, Vol 85, No 3, p 8, Mar 1970.

Descriptors: *Water pollution, *Costs, Storm runoff. Overflow

Identifiers: Storm sewers, Sewer separation.

This short review summarizes environmental problems in the United States such as water pollution, refuse collection and disposal, mineral depletion, and air pollution. Under water pollution, it is noted that \$48 billion is required to separate sewers in the U.S. in order to correct effects of stormwater overflow. Grim predictions concerning the environment are made, and immediate action to improve conditions is advocated. W71-06627

SAIGON'S SEWER NEEDS STUDIED.

Eng News-Record, Vol 183, No 5, p 16, Jul 31,

Descriptors: Investigations, *Water pollution sources, *Drainage systems, Storm runoff, Sewerage, Water pollution control, Sewers. Identifiers: *Saigon River, Vietnam.

The Agency for International Development (AID) is conducting a 15-month, \$800,000 study to discover the most efficient and economic sewer system for the disposal of Saigon's sewage and stormwater runoff. The present system is almost entirely non-functioning and as a result, the waterways of the city, including the Saigon River, are highly polluted with human waste and refuse. One plan to be explored is a drainage canal system for stormwater that would double as a transportation system. The results of the study will be used to support requests for financial assistance for reconstructing Saigon's sewers. W71-06630

WATER POLLUTION -- COAST TO COAST.

Environ Sci Technol, Vol 3, No 9, p 804-805, Sep

Descriptors: *Municipal wastes, *Pollution abatement, Sewage disposal, Thermal pollution. Identifiers: *Combined sewers, *Water pollution.

A report on the FWPCA's regional review notes includes: the municipal problem and the pollution abatement activities; industrial sources of water pollution abounding in the Northeast, Great Lakes, and Ohio regions; agricultural activities; the Northeast problem of combined sewer discharge with 90% of the United States population served by combined sewers located in this area; thermal pollution problems; and salinity. Statistics are given. W71-06633

MEMORANDUM OF EVIDENCE TO THE MINISTRY OF HOUSING AND LOCAL GOVERNMENT WORKING PARTY SEWAGE DISPOSAL.

Committee from the Inst. of Water Pollution Con-

For primary bibliographic entry see Field 05E. W71-06636

LAKE COUNTY ADOPTS CLEAN LAKE POL-ICY, R. E. Anderson.

Water Sewage Works, Vol 115, No 11, p 412-415, Nov 1968.

Descriptors: *Sewage effluents, *Sewage treatment, *Water pollution control, Hydraulics. Identifiers: *Lake County, Illinois, *Storm sewage, Capacity.

Effluents from sewage works of the North Shore Sanitary District, Lake County, Illinois, will be discharged into the Des Plaines river instead of into Lake Michigan, thus reducing pollution of the lake.

Those works giving primary treatment only will be abandoned, and their services absorbed in expansion programs of other works. The capacity for storm sewage flows is to be increased, so that storm sewage will not enter the lake but will be pumped to works for treatment after the storm. W71-06638

HANDBOOK OF STEEL DRAINAGE AND HIGHWAY CONSTRUCTION PRODUCTS For primary bibliographic entry see Field 08A.

STATUS AND PROPOSED CONTROL OF POL-LUTION IN BOSTON HARBOR AND ITS TRIBUTERIES.

John J. Flaherty

J Boston Soc Civil Eng, Vol 55, No 4, p 221-230,

Descriptors: *Pollution abatement, Sewerage, Discharge, Overflow, Storm runoff.

Identifiers: *Boston, Separate system, Deep tunnel

plan, Combined sewers.

Stormwater overflows from combined sewerage systems and from industrial wastes is the principal cause of river pollution in the Boston area. About 100 outlets into the Harbor and its tributaries are affected by Boston storm overflows and combined sewer discharges from neighboring communities. Four principal alternative methods of pollution abatement for the area are: (1) complete separation of all sanitary sewerage and storm drainage systems, (2) construction of chlorination detention tanks, (3) construction of surface holding tanks, and (4) implementation of the deep tunnel plan. Engineers recommend the construction of sanitary sewers and storm conduits wherever existing principal design flows or runoff from 15-year frequency design rainstorms. The governmental agencies responsible for pollution control, as well as various studies and approaches to alleviation and abatement methods are listed. Results indicated that the most positive method of collecting and disposing overflows of mixed sewage and stormwater is the deep tunnel plan. W71-06649

ON WATER POLLUTION CONTROL POLICY,

Thomas R. Camp.

Eng News-Record, Vol 181, No 7, p 22-23, Feb 12,

Descriptors: *Pollution abatement, *Regulation, Storm drains, Sewer separation.

Identifiers: *Construction grants, *Combined sewers, *Viewpoint.

The author criticizes the FWPCA's new policy of refusing construction grants for projects that provide less than 85% removal of five-day BOD, because this requirement does not cover the oxygen demand of ammonia (derived from human urine) or of combined sewer overflows. This policy would eliminate aid to most communities since many areas have combined sewer overflows. Big cities are cited as having the worst water pollution problems because they utilize storm drains as combined sewers, and street congestion hinders sewer separation. Chicago's alternate solution of underground deep rock storage tunnels for sewage is described and praised. The following recommendations are made towards achieving pollution abatement: (1) authorization for grants-in-aid to solve combined sewer problems; (2) mandatory heavy chlorination of sanitary sewage; (3) water pollution control authorities to manage watersheds; and (4) FWPCA's promotion of further legislation required to carry out the above aims. W71-06653

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COOLING WATER SOURCES FOR POWER GENERATION, Westinghouse Electric Corp., East Pittsburgh, Pa.

Power Systems Planning. Louis G. Hauser.

ASCE Proceedings, Journal of the Power Division, Vol 97, No PO 1, Paper 7804, p 123-133, January 1971. 11 p, 9 fig, 6 tab.

Descriptors: *Water sources, *Cooling water, *Thermal powerplants, Thermal pollution, Systems analysis, Optimization, Electric power production, Nuclear powerplants.

Identifiers: Cooling water sources.

A forecast of thermal discharge growth by type of generation is derived from a forecast of electric generation, an estimate of generation mix, and the expected heat rates for each type of plant. Alternate methods of heat dissipation are explained and economically evaluated in terms of incremen-tal cost additions to a base generation cost for once-through fresh water cooling. Generation cost increases are shown to be less than 5% for each type of cooling except for nonevaporative dry cooling. A survey of plant locations which includes a cost comparison of supplemental cooling at the load center versus power transmission from a oncethrough cooling water source indicates that approximately 70% of future generating stations will require supplemental cooling systems. Two cases of cooling tower cost optimization performed on a specific plant demonstrate how significant savings on a present worth basis can be obtained when more sophisticated analytical techniques are applied. (Knapp-USGS) W71-06671

PROPOSED FEDERAL FUNDING FOR CON-STRUCTION OF COMMUNITY WATER AND SEWAGE FACILITIES.

For primary bibliographic entry see Field 06E. W71-06689

BUILDING PLANS AS A BASIS FOR THE DESIGN OF WATER AND SEWAGE WORKS,

Gas Wasserfach (GAWFAN), Vol 107, p 32-36,

Descriptors: *Planning, *Hydraulic engineering, Water pollution sources. Identifiers: *Germany.

The federal German building plan of 1960 can also be applied to hydraulic engineering. The number of future inhabitants per 103 sq. m. for town and country planning is calculated by statistical analyses and also represents an overall basis for the future requirements of water supplies and sewage treatment facilities. This plan takes into consideration the average rainfall and the pollution potential of the population. W71-06745

A SIMULATION TECHNIQUE FOR ASSESSING STORM AND COMBINED SEWER SYSTEMS,

John A. Lager. In: Combined Sewer Overflow Seminar Papers, Edison, NJ, Nov 4-5, 1969 Water Pollution Control Research Series, Report DAST-37, p 151-170, Mar 1970. 5 fig, 4 tab, 11 ref.

Descriptors: *Simulation analysis, *Assessments, *Computer programs, *Storm runoff, Water pollution control.

This paper describes work in progress to develop an assessment technique for comparing alternate solutions through a comprehensive computerized program capable of 'representing urban stormwater runoff phenomena, both quantity and quality, from the onset of precipitation on the basin, through collection, conveyance (both combined and separate systems), storage, and treatment systems to points downstream from outfalls which are significantly affected by storm discharges'. The

program is intended for use by municipalities, government agencies, and consultants as a tool for evaluating the pollution potential of existing systems, present and future, and for comparing alternate courses of remedial action. W71-06746

A PLAN FOR ENDING LAKE ERIE POLLU-TION, James C. Lamb.

Public Works, Vol 100, No 6, p 79-82, Jun 1969.

Descriptors: *Pollution abatement, Storm runoff, Sewage treatment, Separation techniques, *Lake Erie, Water quality.

Identifiers: Combined sewers.

Sources and effects of pollutants in Lake Erie are described along with plans and recommendations for the elimination of pollution from the lake. Urban runoff and combined sewer overflows are major sources of pollution contributing BOD, bacteria, and nutrients--especially phosphorus. Detroit, Cleveland, and Toledo are the largest of-fenders in the area of storm water runoff. Suggested state water quality programs are outlined in addition to areas requiring research and development such as: tertiary treatment, nutrient removal, sediment evaluation, pesticide pollution, radioactive and thermal pollution, industrial sludge disposal, oxygen deficient zones, and eutrophication. Expensive separate sewerage systems are recommended only where feasible, such as in redevelopment projects. However, where combined sewers exist, overflows should be disinfected before being discharged to a body of water, and future plans for storage and treatment should be made. W71-06747

THE 1969 FLOODS,

John A. McCollum.

Calif Water Pollution Control Assoc 42nd Annual Conference, Apr 29-May 1, 1970, Sacramento,

Descriptors: *Damages, *Sewers, *Storm drains, *Repairing, California, Water pollution control. Identifiers: *Los Angeles (Calif).

This paper describes the damage to the sewer and storm drain systems in the City of Los Angeles during and subsequent to the winter rains of January and February 1969. Emergency repair work, performed by forces of the Bureau of Sanitation of the Department of Public Works under adverse conditions, resulted in the protection of public and private property from costly damages. Steps taken to insure the health and sanitary condition of the citizenry included restoration of sewer lines, repair to channels and debris basins, and alleviation of slide potential. Damage was also experienced on a county-wide basis and a summary of events shows the interrelationships involved in emergency repair work performed. W71-06749

ST. LOUIS FLOOD PROTECTION: INTERIOR DRAINAGE.

For primary bibliographic entry see Field 08B.

CONSERVATION PROGRAMS IN THE URBAN FRINGE.

For primary bibliographic entry see Field 04C. W71-06751

UNDERFLOW SEWERS FOR CHICAGO,

Milton Pikarsky, and C. J. Keifer. Civil Eng, Vol 37, No 5, p 62-65, May 1967. 2 diag,

Descriptors: *Design, *Sewers, *Overflow, *Planning, *Tunnels, Costs, Construction equipment, Computer models, Underflow, Water pollution control

Identifiers: *Deep tunnel plan, *Chicago, Comhined sewers.

Chicago is planning an underflow sewer system consisting of a large tunnel under rivers and canals into which all combined sewers will discharge. This system, costing \$400 million dollars, will eliminate the need for a \$4 billion dollar conventional separate sewer because spillages from combined sewers will be directed to the underground tunnel rather than polluting surface streams. The performance of the Lawrence Ave. underflow sewers was analyzed through a computer simulation of the system. Untreated overflow into local streams was reduced from 3%/year of the sewage from com-bined sewers to .8% from Lawrence Ave.'s underflow sewers. W71-06752

SYSTEM DESIGN,

For primary bibliographic entry see Field 08B. W71-06756

BRITAIN AND THE AMERICAN WATER **OUALITY CRISIS.**

Richard Wood.

Effluent Water Treat J, Vol 10, No 6, p 316-317, 319-321, Jun 1970.

Descriptors: *United States, *Cost analysis, *Comparative costs, Equipment, Standards, Pollution abatement, Water pollution control. Identifiers: *Great Britain.

Britain's shortcomings with regard to water pollution control stem from a failure of financial investments in control plants to keep pace with the changing technology of industrial processes and their effects on both domestic and mixed-municipal sewage. A comparative cost analysis between Britain and the United States concerning water pollution control is discussed including: cost percents appropriated for equipment, industrial waste treatment, municipal sewage treatment, and river pollution abatement. Basic purification standards are included as well as effluent standards. The author expands on the idea that the exportation of pollution control equipment such as instrumentation and control systems to the United States is one area in which the British may contribute their technological advances in aiding both the United States and Britain. W71-06757

MUNICIPALS WANT NEW CENTRAL BODY FOR WATER AND SEWAGE.

Surveyor, Vol 85, p 37 and 48, Apr 1970.

Descriptors: *Future planning (Projected), *Legal aspects, *Regulation, *Administration, Water pollution control

The setting up of a central body, with much wider responsibilities than those of the present Water Resources Board, to plan, initiate, or coordinate action over the whole field of water resources and sewage purification and disposal, is proposed by the Institution of Municipal Engineers. The following points we discussed: the inadequacy of the present form of organization for the future: water supply and effluent disposal planning; standards research; and the delegation and determination in regards to responsibilities of river boards and local government bodies (i.e. surface water sewerage, positioning of surface water overflows and out-W71-06762

MERSEY RA STANDARDS FOR EFFLUENTS. Surveyor, Vol 84, No 4039, p 98, Nov 7, 1969.

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Descriptors: *Standards, *Sewage effluents, *Sewage disposal, Overflow, Water pollution con-

Identifiers: *Effluent standards, *Great Britain. Trade effluents, Storm sewage.

The Mersey and Weaver River Authority defined effluent standards in accordance with relevant local conditions. Standards were developed for the following areas: (1) purified sewage effluents discharged to inland rivers (normally applied to rates of flow up to 3 d.w.f.); (2) partially treated sewage effluents discharged to rivers (normally applied to rates of flow in excess of 3 d.w.f.); (3) untreated sewage effluents from storm sewage overflows; (4) sewage effluents discharged to tidal waters; and (5) trade effluents. W71-06763

NEW AND PROPOSED LAWS.

Paul R. Bonderson.

Paper presented at the Calif Water Pollution Control Assoc, 42nd Conference, Sacramento, Calif, Apr 29 to May 1, 1970.

Descriptors: *Legislation, *Water quality control, *Water pollution control, *Legal aspects, *California, *Water quality act.

The Porter-Cologne Water Quality Control Act, a complete revision of the State's water quality laws, became effective January 1, 1970. The Act accomplishes the following objectives: (1) grants the State Board expanded powers to provide more leadership and greater influence over activities of regional boards; (2) requires regional boards to adopt more restrictive water quality control plans and discharge requirements so that better pollution control will be achieved; and, (3) makes major changes in enforcement procedures, including court assessment of \$6,000 per day fines, which will give boards much more effective means for taking enforcement actions. Indications are that over 1,000 environmental quality control bills will be considered during the current legislative session. Consideration will be given to having a State sewage construction grant program. Major proposed water pollution control legislation will be summarized. W71-06764

THE RESPONSIBILITY OF TREATMENT PLANT OPERATORS UNDER THE PORTER-COLOGNE WATER QUALITY CONTROL ACT, Jerome B. Gilbert.

Paper presented at the Calif Water Pollution Control Assoc, 42nd Annual Conference, Sacramento, Calif, Apr 29 to May 1, 1970.

Descriptors: *Water quality act, *Water pollution control, Water quality control, *Regulation, *Administrative agencies.

The State Water Resources Control Board and the nine California Regional Water Quality Control Boards are the state agencies responsible for control of water pollution and water quality. The Porter-Cologne Water Quality Control Act greatly strengthens and expands powers and duties of these agencies. Although there are many factors contributing to the degradation of water quality, discharges from municipal and industrial waste treatment plants are still the principal cause of water quality problems. Under the new law, requirements will be made further restrictive resulting in highly sophisticated and more com-plicated treatment plants. Exacting performance by operators in charge of plants will be needed to prevent violation of requirements and to collect fines up to \$6,000 per day. To help assure that qualified operators will be in charge, the State Board will classify all treatment plants and specify the level of competence necessary to operate them. The Board will also specify the training necessary to quality an operator for each level of competence. All operators should take advantage of training opportunities in order to qualify themselves for new levels of operating competence.

W71-06766

ESTABLISHMENT OF WATER QUALITY STANDARDS IN THE CITY OF TAKAMATSU. Takishi Ishibashi.

Sangyo Kogai, Vol 6, No 6, p 372-382, Jun 25,

Descriptors: *Standards, *Water quality, *Systems analysis, *Investigations, *Water pollution treatment

Identifiers: Japan.

An urban river system was employed to establish water quality standards in the Takamatsu area. Normally the standard is established by an investigation of the individual source of pollutants. In large cities where numerous sources exist, an exhaustive investigation is impractical; consequently, an average water quality standard, based on a sampling investigation of primary sources of pollutants, together with considerations of the special properties of the water area are taken as a basis in establishing the individual standard. This new system was effective in expediting the formulation of the standard. The general situation of the water area in question, status of water utilization, water pollution, results of investigations on water quality. pollutants' source, planning of the public sewage system, and future prospects of water pollution are presented. Basic factors considered in establishing and finalizing the water quality standard are given. Discussions made at committee meetings for establishing the standard are also included.

THE SEWERAGE (SCOTLAND) ACT 1968,

Dugald McDonald. Surveyor, Vol 84, No 4036, p 46-48, and 51-53, Oct 17, 1969. 3 fig.

Descriptors: *Legislation, *Sewerage, *Sewerage disposal, *Sewers, *Prior appropriation, Jurisdiction, Local governments, Water pollution control, Industrial wastes

Identifiers: *Trade effluents, *Scotland.

The Sewerage Scotland Act is described as a modern, comprehensive code governing sewerage, sewage disposal, and trade effluents. The act is divided into three parts: sewerage, trade effluents, and a supplemental part. The following subjects included in the act are discussed in the first part: local authority to provide sewerage, sewer maintenance, sewers vested in local authority, new sewer construction, sewer connections, joint sewerage and sewage disposal, highway drainage, septic tanks, adoption of private sewage works, defective drainage, abolition of special drainage districts, and prohibition on buildings erected on sewers. The part on trade effluents includes: the right to discharge to sewer, and existing and new discharges. The supplemental section reviews: the rights to sewage, powers of entry, sampling sewage, prohibition on harmful substances, application to the Crown, and settlement of appeals and disputes.

PORTER-COLOGNE ACT REVISITED,

Ronald B. Robie.

Paper presented at the Calif Water Pollution Control Association, 42nd Annual Conference, Sacramento, Calif, Apr 29 to May 1, 1970.

Descriptors: *Legislation, *California, Water quality control, *Water quality act, *Legal aspects, Water pollution control.

The Porter-Cologne Water Quality Control Act, effective January I this year, provides the State
Water Resources Control Board and the nine California Regional Water Quality Control Boards with the 'tools' to implement and carry out an effective water quality control program. The new law is geared to enhance the water environment as well as to prevent water pollution. This is evidenced by the inclusion of esthetic enjoyment and the preser-

vation of fish, wildlife and other aquatic preserves among the water uses to be protected. Other major provisions of the new law include: civil fines up to \$6,000 per day for violation of cease and desist or-ders relative to a waste discharge; payment of a filing fee not exceeding \$1,000 to accompany a report of a proposed or material change in a waste discharge; mandatory cleanup of pollution by a violator with full liability for cleanup costs; and integration of water quality into consideration of water rights, including appropriation of water by storage to be released in order to protect or enhance water quality. W71-06769

UTILIZATION OF STREAM FOR STORM DRAINAGE,

D. A. Schneider.

Public Works, Vol 98, No 4, p 87, Apr 1967.

Descriptors: *Legislation, Drainage districts, *North Carolina, Water pollution control.

As the Court stated in a North Carolina case, municipalities can be held liable for damages caused by their failure to maintain proper sewer conditions including good drainage and freedom from obstruction. Thus, when a locality utilizes a natural waterway for sewerage and drainage, it is obligated to keep this water in proper condition, and it is liable under the law for damages resulting from neglect to perform this duty. W71-06770

RIVER ENGINEERING AND WATER CONSER-VATION WORKS,

Roland Berkeley Thorn. Butterworths, London, 1966. 520 p.

Descriptors: *Water supply, *Water conservation, *Engineering education, Legislation.
Identifiers: *River engineering.

The editor collected articles by twenty-three authors, and these, together with his own contributions, form a comprehensive introduction to basic thois, form a compensate interaction to information needed by river authority engineers. The book also includes topics related to water supply engineering and the soil mechanics of flood embankments. With the exception of the first chapter on water conservation and water supply legislation, the emphasis is on engineering subjects and the means for solving major problems arising in river engineering and water conservation works W71-06771

THE USE OF BALANCING RESERVOIRS AND FLOW REGULATING RESERVOIRS IN DEAL-ING WITH RUN-OFFS FROM URBAN AREAS, G. Thompson.

In: River Conservation and Water Conservation Works, Butterworths, London, Chapter 9, p 132-141, 1966. 6 fig, 5 ref.

Descriptors: *Surface drainage, *Flow control, *Regulated flow, *River systems, *Design criteria,

Identifiers: *Urban runoff, *Flow balancing.

This chapter attacks the problem of increased runoff from a river caused by urban development and the installation of surface water drainage. Such a problem ensues wherever more paved areas are directly connected by sewers to a river. As a solution, the author recommends flow balancing, which entails passing the flow through a natural or artificial lake with a restricted outflow, or flow regulation, in which part of the river flow is passed into specially-prepared areas. These plans can be economical, and they reduce peak flows and also channel sizes farther downstream. General design factors for implementing flow balancing and regulation are discussed; and then a scheme combining the two principles, which was applied to the River Cray, is described. Flow balancing is possible in new or undeveloped towns; whereas, it cannot

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usually be implemented in a built-up area unless lakes or disused mine workings are available. In such urban areas, flow regulation is readily applicable. (See also W71-06771)
W71-06772

APPLIED FLOOD HYDROLOGY,

J. E. Nash.

In: River Engineering and Water Conservation Works, Butterworths, London, Chapter 6, p 63-110, 1966. 22 fig, 1 tab, 23 ref.

Descriptors: *Flood routing, *Rainfall, *Frequency analysis, *Discharge (Water), *Hydrogrograph analysis, *Unit hydrograph, Storm runoff, Rainfallrunoff relationships.

Two problems in flood hydrology are presented: (1) predicting peak discharges from rainfall data and such other factors as are found necessary; and (2) the determination of the frequency of exceedence of a discharge when records of discharge over several years exist or in the absence of such records. The chapter attempts to designate the tools available for solving such problems and the usefullness and limitations of these tools. Topics discussed under hydrograph analysis are: storm runoff from individual storms, rainfall and effective rainfall, the unit hydrograph hypothesis, changing the duration of a unit hydrograph, use of the S curve, calculation of unit hydrographs from rainfall and stream flow records, and uses of a unit hydrograph. The relation between the unit hydrograph and the catchment is explained, as is the volumetric relation between rainfall and runoff. The last two sections explore flood frequency and the relation of flood frequency to catchment characteristics. (See also W71-06771) W71-06773

RUNOFF FROM COMBINED RURAL AND URBAN AREAS,

I. H Watkins

In: River Engineering and Water Conservation Works, Butterworths, London, Chapter 7, p 111-121, 1966. 5 fig, 4 tab, 4 ref.

Descriptors: *Hydrographs, *Hydrologic aspects, Rational formula, Rainfall. Identifiers: *Urban runoff, *Great Britain.

Hydrologic principles of the calculation of runoff from rural areas are also applicable to urban and combined rural and urban catchments. However, traditionally urban runoff has been calculated by a variation of the basic method called the Rational Formula or the Lloyd-Davies formula. This formula has been shown to be reliable only for very small urban catchments, and it is being replaced by the R.R.L. Hydrograph method. This chapter discusses the R.R.L. Hydrograph method based on climatic conditions in Great Britain. In order for this method to be applied elsewhere, suitable rainfall data must be employed and adequate allowance made for increased impermeability of natural surfaces, particularly under conditions of tropical rainfall. (See also W71-06771)
W71-06774

STANDARDS FOR EFFLUENTS IN SWITZER-

Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland).

P. Courvoisier, and B. Mueller.

Available from NTIS as CONF-700 815, \$3.00 in paper copy, \$0.95 in microfiche. Presented at IAEA Symposium on Environmental Aspects of Nuclear Power Stations, New York, August 10-14, 1970, 700810-8. Paper IAEA-SM-146/14

Descriptors: Legislation, *Industrial water, *Thermal pollution.

Identifiers: *Heated effluents, *Nuclear power plants, *Switzerland.

Maximum permissible levels for the release of effluents are stated by different laws, regulations or guide-lines in Switzerland. Policies followed are outlined. A recent addition of general interest is the recommendation of limits for thermal effects in surface waters. As the production of electric energy in Switzerland has been until very recently nearly exclusively by hydro-electric plants, the natural regime of the rivers has not been changed to any appreciable extent by their use as receivers of cooling water. It is possible to use the rivers for the direct cooling of a first group of nuclear power stations. However, the permissible limits for this use of river water had to be identified and fixed in the light of the goals for water protection stated by the Swiss law. A study has demonstrated the need to set up a careful planning for the disposal of heat W71-06792

ODOR CONTROL IN CATTLE FEED YARDS.

W. L. Faith. Air Pollution Control Association Journal, Vol 14, 1964, p 459-460.

Descriptors: *Farm wastes, *Odor, *Mechanical Descriptors: Fathir Gastes, Option, Disposal. Identifiers: *Feedlots, *Chemical control, Odor counteractants, Masking agents, Disinfectants, Potassium permanganate.

This paper deals with the experimental odor control program initiated in 1961 at the Roy F. Benton Feed Yards in Walnut, California, after complaints were received from a nearby residential area. A variety of methods to reduce odor to an acceptable level have been tried with varying results. A highly satisfactory procedure is based on 'good housekeeping' practices, frequent removal of fecal material, and abatement of residual odor by spraying the lots at designated intervals with a solution of potassium permanganate. Details of the method are discussed. (Christenbury-Iowa State) W71-06803

ACCELERATION OF NATURAL DRYING OF POULTRY MANURE THROUGH MECHANICAL AGITATION,

California Univ., Davis.

James A. Moore, and Samuel A. Hart. Unpublished paper. Presented Pacific Coast Region American Society of Agricultural Engineers, 1968. Paper No PC 68-121. 2 fig, 2 ref.

Descriptors: *Farm wastes, *Sublimation, Drying, Moisture content, Till, Winter, Freeze drying, Freezing, Equipment.

Identifiers: Relative humidity, Tiller drying, Natural drving.

Wet manure rather quickly becomes objectionally odorous. One solution to the manure problem would be an economical and efficient means of reducing the moisture content. The concept of sublimation was evaluated as a means of natural drying of poultry manure. The use of a mechanical agitator was incorporated into the system. The drying phenomenon that allows clothes to dry in winter weather would not work with manure. The tiller-drying to accelerate natural drying of manure in summer was very effective. (Christenbury-Iowa State) W71-06804

CONTROLLING ODORS FROM CATTLE FEED LOTS AND MANURE DEHYDRATION OPERA-

Memphis Cattle Feeders, Inc., Millington, Tenn. Robert Moorman, Jr.

Air Pollution Control Association Journal, Vol 15, 1965, p 34-35.

Descriptors: *Farm wastes, *Odors, Legal aspects, Dehydration, Spraying, Disposal, Management. Identifiers: *Feedlots, Public relations.

This paper discusses various methods of odor control for cattle feed lots. The human and physical conditions that exist which allow and cause odor problems to arise and become a community source of trouble are discussed. These include a negative attitude and a lack of understanding on the part of the parties concerned. The odor problems can be alleviated through cooperation and sincere effort. The use of dehydration units have been only partially successful. Public relations between feed lot and the community are very important. (Christen-bury-lowa State) W71-06805

PROCEEDINGS OF FARM ANIMAL WASTE AND BY-PRODUCT MANAGEMENT CON-

Wisconsin Univ., Madison.

University Extension, The University of Wisconsin, November 6-7, 1969. 129 p.

Descriptors: *Farm wastes, *Cattle, *Hogs, *Poultry, *Environment, Social aspects, Economic, Political aspects, Psychological aspects, Air pollution, Water pollution, Soil contamination. Identifiers: *Management conference.

This conference was held for technical and administrative staff of local, state, regional and federal agencies; for industries and for private citizens who are concerned about or have a responsibility related to the proper management of wastes from farm animal enterprises in Wisconsin. It was an introductory meeting at which the dimensions of the problems were examined, research was reviewed, some alternative manure handling methods were highlighted, public agency roles were outlined and two existing local programs were described. Small group discussions explored future program and research needs. (See also W71-06811 thru W71-06832) (White-Iowa State) W71-06810

INTRODUCTORY REMARKS,

Wisconsin Univ., Madison. Coll. of Agriculture.

Glenn S. Pound.

In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, November 6-7, 1969, p 15-16.

Descriptors: *Environment, *Agriculture, Industries, Populations, Priorities, Farm wastes, Food abundance, Education, Research and development. Cattle

Identifiers: Agricultural power, Industrial power, Meat consumption, Public commitment.

The author points out the public commitment which was made and which today has made America the world's greatest agricultural and industrial power. In our progress we have done real harm to our environment. Public awareness is needed to establish new priorities. To establish new priorities will take courage, great understanding and tolerance. Education and research is badly needed. Vast expenditures of money will be required to reverse the tide. (See also W71-06810) (White-Iowa State) W71-06811

QUANTITIES AND CHARACTERISTICS OF FARM-ANIMAL WASTES,

Public Health Service, Chicago, Ill. Bureau of Solid

Waste Management. Ralph J. Black, and William Q. Kehr.

In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, November 6-7, 1969, p 17-21. 3 tab, 6 ref.

Descriptors: *Farm wastes, *Water pollution, Population, Pollution abatement, Confinement pens, California, Solid wastes, Dissolved oxygen, Water quality, Hogs, Cattle, Poultry, Nutrients, Sewage sludge.

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Identifiers: Meat consumption, Livestock production, Population equivalent, Land disposal.

The paper points out that an increased population will require much more beef and poultry, thus increasing the agricultural waste problem. Confinement feeding is firmly established, and, while the number of feeding operations is expected to decline, the total production will be increased. The importance of agricultural wastes is brought out in a table showing quantities of solid wastes generated in California. This is magnified by population equivalent data which states that animal wastes were equivalent in pollutional affect to 10 times that of the nation's population. Data is presented on quantities produced and the nutrient value of animal wastes. It is economically unfeasible to utilize this waste for its fertilizer value. The quantity of animal wastes will increase, as will the management problems associated with its handling, treatment and disposal. (See also W71-06810) (White-lowa W71-06812

HEALTH PROBLEMS,

Wisconsin Univ., Madison. Dept. of Bacteriology. Elizabeth McCoy.

In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, November 6-7, 1969, p 22-24.

Descriptors: *Public health, *Farm wastes, *Bacteria, Water pollution, Soil contamination, Coliforms, E. Coli, Streptococcus, Soil, Loam, Rates of application, Sampling, Cores, Adsorption,

Identifiers: *Enterocci, Miami silt loam, Die-off.

Animal wastes contain enormous amounts of pollution bacteria. If it finds its way to surface or well waters the water would be reported as 'contaminated.' Bacterial counts made on fresh feces gave the following values: Coliform, 100,000 - 1,000,000/gm.; Enterococci, 1,000,000 -10,000,000/gm. Experiments were done to trace pollution bacteria in manure applied to soil. Five gallon pails (with bottoms cut out) were set to about three-fourths of their depth in a field of Miami silt loam. Applications of a manure/water slurry were made in 15, 30, and 80 tons per acre amounts. Both types of bacteria were adsorbed with \$98..% removal by 14 inches. The soil acts as a very efficient filter. (See also W71-06810) (White-Iowa State) W71-06813

AESTHETICS AND ODORS,

Wisconsin Dept. of Natural Resources, Madison. Douglas Evans.

In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, November 6-7, 1969, p 25-26.

Descriptors: *Farm wastes, *Odors, Aesthetics, Anaerobic conditions, Hydrogen sulfide. Identifiers: *Odor threshold, Public nuisance, Odor panel, Odor measurement.

The difficulty of evaluating the offensiveness of odors is their subjective nature. Odors from farm animal wastes, particularly anaerobically generated are, in general, offensive, but the substances involved and the thresholds of detection are little known. Typical odor thresholds are given when determined by a trained panel. A method is outlined for eliminating panel members insensitive to odors. More needs to be known about the type, quantity and odor threshold of the various compounds involved in farm animal wastes. From this better methods of treating, storing, handling and disposing of wastes may be developed which will reduce or eliminate the odor problem. (See also W71-06810) (White-Iowa State) W71-06814

DEAD ANIMALS AND HOW THEY CONTRIBUTE TO POLLUTION OF THE ENVIRON-

Department of Agriculture, Madison, Wis. A. A. Erdmann.

In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Ex-tension, University of Wisconsin, November 6-7, 1969, p 27-29.

Descriptors: Transportation, Costs, Livestock, Legislation, Water pollution, Environment, Wisconsin.

Identifiers: *Dead animal disposal, *Rendering plants, Slaughter plant scraps, Carcasses.

The article describes why dead animals are fast becoming a pollution problem. Where once rendering plants paid to pick up dead animals they now charge livestock owners a fee for pick-up and disposal of livestock losses. The number of dead animals being sent to rendering plants has decreased by about 50%. Some legislation concerning the problem is encouraging. The author expects the problem of dead animal disposal to increase in the future. The problems of the rendering plant industry, such as added labor costs, collection costs, and, perhaps most important, the inferior product resulting from such operations, will probably make it necessary to use a different method of disposal of dead animals than is now followed. (See also W71-06810) (White-Iowa State) W71-06815

WATER QUALITY PROBLEMS, Wisconsin Dept. of Natural Resources, Madison. F. H. Schraufnagel.

In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 30-32, November 6-7, 1969. 7 ref.

Descriptors: *Water quality, *Farm wastes, Water pollution sources, Fishkill, Fish, Dissolved oxygen, Nutrients, Nitrogen, Nitrates, Phosphorus, Eutrophication, Base flow, Ammonia, Coliforms, Cattle, Wisconsin.

Identifiers: *Land disposal, Concentrations, Feedlots.

Probably the biggest concern in Wisconsin about pollution from farm animal wastes is because of their nutrients. Nitrogen and phosphorus are the two significant nutrients causing eutrophication in lakes and streams. Land disposal is usually an effective way to prevent pollution except when wastes are applied to frozen ground. Data from the nutrient content of base flows generally indicates that percolation through the ground eliminates most of the phosphorus and nitrogen. The potential for pollution from animal wastes is very great. The likelihood of pollution from cattle will increase with manure fluidization and water carriage systems. The maintenance of water quality depends on research and development of techniques to control the problem. (See also W71-06810) (White-Iowa State) W71-06816

FUTURE TRENDS IN LIVESTOCK PRODUC-TION.

Wisconsin Univ., Madison. Coll. of Agriculture. Robert W. Bray.

In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 33-35, November 6-7, 1969.

Descriptors: *Farm wastes, *Livestock, Cattle, Poultry, Hogs, Automation, Confinement pens, Odors, Waste disposal.
Identifiers: *Livestock numbers, Dairy cattle, Beef

cattle, Feedlots, Horses, Waste management.

The author summarizes the article by saying that (1) livestock numbers will increase in the future and (2) the most economical management systems

for all classes of livestock will result in larger numbers and more confinement in each livestock enterprise. Thus, the solid waste management or disposal problems associated with livestock production in Wisconsin will become more complex. The author gives his ideas as to what changes in production can be expected for dairy, beef, wine, poultry, and other operations. (See also W71-06810) (White-Iowa State) W71-06817

WHAT AND WHERE ARE THE CRITICAL SITUATIONS WITH FARM ANIMAL WASTES AND BY-PRODUCTS IN WISCONSIN,

Wisconsin Univ., Madison.

M. T. Beatuny, J. E. Kerrigan, and W. K. Porter.
In: Proceedings of Farm Animal Waste and ByProduct Management Conference, University Extension, University of Wisconsin, p 36-57,
November 6-7, 1969. 4 tab, 12 fig.

Descriptors: *Farm wastes, *Wisconsin, *Spatial distribution, Environment, Soils, Surface waters, Groundwater, Land resources, Livestock, Cattle, Groundwater, Land resources, Livestock, Cattle, Hogs, Poultry, Population, Geology, Hydrology, Precipitation, Standards, Water quality, Nitrogen, Nitrates, Odor, Watersheds, Bedrock. Identifiers: *By-products, Earth resources, Soil associations, Critical situations.

Where and to what extent various kinds of critical situations develop, depends on the interaction of several components of the waste production and management system. These include: the kinds and amounts of wastes and by-products produced; the spatial distribution of the sources; the proximity to people; the physical environment- characteristics of the soils, the landscape, the surface water and groundwater systems, and; the uses and demands on water and land resources. Numerous tables and charts point up the importance of these components. Seven critical situations, the problems and locations involved, are then explained. They include livestock concentrations near urban areas, large livestock concentrations, livestock in watersheds with lakes, and livestock concentrations on shallow soils over previous bedrock as well as others. (See also W71-05810) (White-Iowa State) W71-06818

CONSIDERATIONS IN SELECTING DAIRY MANURE DISPOSAL SYSTEMS, Wisconsin Univ., Madison. Dept. of Agricultural

Engineering.

O. I. Berge, E. G. Bruns, T. J. Brevik, and L. A.

In: Proceedings of the Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 58-69, November 6-7, 1969. 10 tab, 1 fig, 1 ref.

Descriptors: *Farm wastes, *Cattle, Labor, Odor, Investment, Storage, Storage tanks, Annual costs, Value, Nitrogen, Phosphorus, Potassium, Urine, Equipment, Wisconsin.

Identifiers: *Dairy cattle, *Manure disposal

systems, Hauling, Stacking, Manure handling.

Different methods of handling dairy manure and disposing of it are discussed. Advantages and disadvantages are listed. The three basic systems include daily hauling, stacking, and liquid manure storage. Investment and annual costs are compared for the three systems under similar stanchion and free stall housing operations. Dairy manure is valued at \$1.40/ton for its nutrient content. Various types of handling equipment are discussed as well as a few disposal methods. (See also W71-06810) (White-Iowa State) W71-06819

ENGINEERING RESEARCH FARM ANIMAL MANURE,

Wisconsin Univ., Madison. Dept. of Agricultural Engineering. Clyde Barth.

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In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 70-79, November 6-7, 1969. 2 tab, 6 ref.

Descriptors: *Farm wastes, *Biological treatment, Disposal, Livestock, Anaerobic digestion, Waste storage, Lagoons, Aerobic treatment, Waste dilution, Temperature, Rotors, Irrigation, Odor, Gases. Identifiers: *Waste management, Waste characteristics, Anaerobic lagoon, Aerobic lagoon, Oxidation ditch, Composting, BOD removal, Land application, Coprophagy, Chemical treatment, Solid-

The article reviews different treatment and disposal methods which are currently being used or investigated. Anaerobic and aerobic lagoons are used but are limited by temperature and odor problems. The oxidation ditch can be used for swine but its use is uncertain for wastes from other livestock. Composting, though effective, lacks a market for its finished product. Land application continues to be the most widely used type of livestock waste disposal. Irrigation and plow-furrow-cover applications are a modification of land disposal. Chemical treatment, dehydration, incineration, coprophagy are being studied, but no conclusions have been drawn. Odor and gas production are problems not well understood and difficult to control. Solid manure, because of the lack of problems associated with its handling, deserves serious consideration in any animal waste handling situation. (See also W71-06810) (White-lowa State)

NATION-WIDE RESEARCH ON ANIMAL WASTE DISPOSAL, Federal Water Pollution Control Administration,

Chicago, Ill. Lake Michigan Basin Office.

Jacob O. Dumelle.

In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 80-81, November 6-7, 1969.

Descriptors: *Farm wastes, *Research development, Grants, Algae, Air pollution, Water pollution, Soil contamination, Nutrients. Identifiers: *FWPCA, Activated algae, Feedlots,

Oxidation ditch

The article gives brief descriptions of research projects which the Federal Water Pollution Control Administration is helping to fund. One such project under way in California is trying to determine the practicability of producing and harvesting algae to remove nutrients from agricultural drainage waters. Other projects involve cattle feedlot runoff, and dairy waste waters. Besides research on treatment methods, some projects are trying to find out how much nutrient runs off, and how much gets into water. (See also W71-06810) (White-lowa State) W71-06821

WATER RESOURCES CENTER RESEARCH ON ANIMAL WASTES AND WATER QUALITY, Wisconsin Univ., Madison. Water Resources

Center. J. E. Kerrigan.

In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 82-85, November 6-7, 1969.

Descriptors: *Farm wastes, *Water quality, Eutrophication, Research and development, Wisconsin, Legislation, Water resources, Environ-

ment, Resources.
Identifiers: *Water Resources Center, Water research.

The function and goals of the University of Wisconsin's Water Resources Center are pointed out. The Center got its start from faculty committees formed to study groundwater and subsequently lakes and streams. It was then assigned state responsibility by

the legislature for the coordination and administration of an interagency water resources research and data collection program. Lists of objectives and functions of the Water Resources Center are given. If Wisconsin is to have a well balanced research program for water quality management, it is necessary to direct the limited available financial support to researchers with specially developed talents to solve specific problems that merit consideration. A generous amount of effort must be expended to identify the real problems. (See also W71-06810) (White-lowa State) W71-06822

THERE'S HOPE AHEAD,

Wisconsin Univ., Madison. Dept. of Poultry

John Skinner

In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 86-90, November 6-7, 1969.

Descriptors: *Farm wastes, *Odor, Land use, Population, Management, Poultry, Foods, Agricul-

Identifiers: Manure handling, Public relations, Goals, Land use planning.

Examples are cited of problems which have been turned into profitable industries; this can also be done with animal wastes. The increasing urban population will demand that animal wastes and their associated odors be disposed of at least cost to the meat consuming public. We must first dedicate ourselves to finding answers to the animal waste disposal problem. We must have full realization and appreciation of the cause, extent and consequences of the problem by all concerned. Better land use planning is needed as well as progressive regulations and laws. Better public relations must be created for all of agriculture and agriculturally related industries. Emphasis is placed on realizing the consequences of what we are doing today. The author proposes a goal of 'rendering inoffensive those parts of animal waste and by-products which are disagreeable to the public in general.' (See also W71-06810) (White-Iowa State) W71-06823

INTRODUCTION TO FEDERAL, STATE AND LOCAL ACTION PROGRAMS TO SOLVE ANIMAL WASTE DISPOSAL PROBLEMS, Wisconsin Univ., Madison. Dept. of Agricultural

Economics.

Douglas A. Yanggen.

In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 91, November 6-7, 1969.

Descriptors: *Farm wastes, Water pollution, Agriculture, Environment, Government supports, Cost sharing, Education, Regulation.
Identifiers: *Government programs, Technical

assistance, Subsidy.

An introduction is given for following articles on governmental programs which include technical assistance, cost sharing, regulation and education at federal, state and local levels. Those included illustrate the various techniques for influencing private decision making. (See also W71-06810) (White-Iowa State) W71-06824

THE ROLE OF THE FEDERAL WATER POL-LUTION CONTROL ADMINISTRATION IN FARM ANIMAL WASTE AND THE BY-PRODUCT MANAGEMENT,

Federal Water Pollution Control Administration, Chicago, Ill. Great Lakes Region. Frank E. Hall.

In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 92-95, November 6-7, 1969.

Descriptors: *Farm wastes, *Water pollution, Research and development, Federal government, Disposal, Grants, Water pollution control, Lake Erie, Water quality, Standards, Legislation. Identifiers: *FWPCA, Animal waste disposal, Agricultural practices, Feedlots, Enforcement actions, Water quality standards.

A discussion is presented stating how the programs of the Federal Water Pollution Control Administration relate to farm animal wastes and by-product management. Examples are given of government and in-house research activities. Mention is given of those FWPCA supported activities that relate directly to the control of pollution from farm animals. These include pollution surveillance and water quality monitoring among others. The author feels that the most significant recent accomplishment in water pollution control is the establishment of water quality standards. (See also W71-06810) (White-Iowa State) W71-06825

TECHNICAL ASSISTANCE AVAILABLE FROM THE SOIL CONSERVATION SERVICE,

Soil Conservation Service, Madison, Wis.

Jack Densmore.

In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 96-97, November 6-7, 1969.

Descriptors: *Farm wastes, *Soil conservation, Surface runoff, Diversion, Grassed waterways, Terracing, Waste storage

Identifiers: *Technical assistance, Soil Conservation Service, Farm waste disposal, Feedlot.

Situations in which technical assistance from the Soil Conservation Service (SCS) might be useful for reducing pollution from farm wastes are listed. Although the list is not all inclusive it gives an idea of assistance that can be obtained. An inventory and analysis of existing and potential areas where farm waste disposal may be a problem is needed. Technical assistance is available from the SCS to help on farm waste disposal problems, under the following limitations: (1) where the solutions involve techniques of soil and water conservation; (2) with the priorities established from time to time by local soil and water conservation district supervisors; and, (3) within the limitations of available man-power. (See also W71-06810) (White-lowa State) W71-06826

COST-SHARING UNDER THE AGRICUL-TURAL CONSERVATION PROGRAM,

Agricultural Stabilization and Conservation Service, Madison, Wis.

Kenneth H. Hoover

In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 98-100, November 6-7, 1969.

Descriptors: *Farm wastes, *Cost sharing, Pollution abatement, Soil conservation, Water conservation. Sedimentation.

Identifiers: ASCS, *Agriculture Conservation Program.

Practices and objectives of the Agricultural Conservation Program (ACP) have been broadened to include pollution abatement, provided such practices also result in soil and/or water conservation. The Agricultural Stabilization and Conservation Service (ASCS) manages program funds of the ACP. A list of components that ought to be included in pollution abatement cost-sharing practices is given. Most practices receive cost-sharing at 80% of cost. Farmer acceptance and financial contribution are needed to accomplish the stated objectives. (See also W71-06810) (White-Iowa State) W71-06827

Water Quality Control—Group 5G

THE REGULATORY ROLE OF THE DEPART-MENT OF NATURAL RESOURCES.

Wisconian Dept. of Natural Resources, Madison Div. of Environmental Protection.

fa: Proceedings of Farm Animal Waste and By-Product Management Conference, University Ex-tension, University of Wisconsin, p 101-104, November 6-7, 1969.

Descriptors *Farm wastes: "Legislation: Water polition Polition abatement: Wasconsin, Water quanty. Regulation, Industrial wastes.

Identifiers "Department of Natural Resources.

Stanutes which point out the authority for Wisconsin water pollution abatement are cited. Other statutes are aimed at prevention and enforcement of sporadic discharges into streams. Based on these utes, it is clear that the Wisconsin Department of Natural Resources has adequate authority to implement a program of pollution abatement aimed at any source of pollution. Difficulties in imperientamen metude tradment procedures and lack of staff and funds. Any solution to the complet animal waste problem will in olive a mix of programs combuning regulation, research, education, financial assistance collistary actions by landowiters and possions even tolerance on the part of the non-farm

COLUMBIA COUNTY PROGRAM.

Columbia County Office, Portage, Win

In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 105-107, November 6-7, 1969.

Descriptors: *Farm wastes, *Nitrates, Water pollution, Air pollution, Odor, Pollution abatement, Zoning, Wells, Wisconsin.

Identifiers: Feedlots, Livestock concentration.

The Columbia County Extension Service was charged with formulating a 15 man farmer committee to study the present situation in . se - of pending proposed requirements of animal and agricultura. waste disposal. It will make recommendations for preventing agricultural pollution in current problem areas and in expanding agricultural enterprises. A joint program by Columbia County, Health Services. Zoning Administration and the University Extension formulated a project to sample well water for nitrates. Over 800 wells have been sampled. Forty-three percent of the high nitrate problem is on farms with high concentration of livestock. The public's demand for clean air, water and environment can be met by programs which involve the items of concern mentioned as well as others. (White-lowa State) W71-06829

WHAT ARE THE PROBLEMS IN WALWORTH

COUNTY, Walworth County Zoning and Sanitation Office. Elkhorn, Wis.

James Johnson

In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 108-110, November 6-7, 1969.

Descriptors: *Farm wastes, *Water pollution, *Zoning. Pollution abatement, Eutrophication, Nutrients, Water resources, Land use, Lakes, Urbanization, Education, Erosion control, Land development, Regulation, Wisconsin.

Identifiers Problem areas, Soil capabilities. Feedlots, Regional Plan.

Increased urbanization resulting in land use conflicts is the overall problem in Walworth County, Wisconsin. As a result, the water resources are

deteriorating at an alarming rate. Eutrophication, erosion and outrient pollution are the major pauses. The Regional Plan, properly implemented will regulate growth in such a way as to prevent many blems before they occur. The Walworth County Sannary Cromance was a pronessing effort in boluton protes which regulated when growth through the use of soil surveys. The Ordinance will ment coming by defining "County Conservation Standards'; which are all of the recommended conservation practices of the Soil Conservation Service. Much can be accomplished with local regulations, but education is essential to sell the program. (See also W71-06810) (White-Iowa

ROLE OF UNIVERSITY EXTENSION, Wisconsin Univ., Madison, Div. of Economic and Francisco Development

In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wiscousin, p 111-113. November 6-7, 1969.

Descriptors *Farm wastes. *Environment Education. Universities. Research and development. Regulation. Water pollution. Wisconstr. Identifiers "University Extension, Adult educa-

The challenge to Extension lies in the broad and continuous education of the public so that a pleasing and healthful environment may be maintained The University Extension combined with the technical, financial and regulatory resources of other state and federal agencies has the resources to reduce the animal waste management problem. The University Extension staff has the responsibility to help various groups and the public to understand the problems and the alternatives; to helppeople who need to organize for action to do so: and to help groups and individuals to know what they can do, how to do it, and what resources are at their disposal. (See also W71-06810) (Whitelowa) W71-06831

WHERE DO WE GO FROM HERE.

Wisconsin Univ., Madison. Dept. of Meat and Animal Science

Richard H. Vilstrup.

In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 114-115, November 6-7, 1969.

Descriptors *Farm wastes, *Environment, Wisconsin, Technology, Education, Research and development, Regulation, Legislation.

Identifiers: Waste management, Waste utilization

The author attempts to briefly summarize the ideas and presentations made at the conference. He points out that the waste management problem has many dimensions, including environmental, social, economic, physical, political and psychological. There is an increasing concern for the quality of environment in Wisconsin. As such, research and education are needed in many areas. Five specific recommendations for continued emphasis in the waste management area are made. Recommendations are also made for educational development. (See also W71-06810) (White-lowa State)

WATER SUPPLY AND WASTE DISPOSAL,

W. A. Hardenbergh, and Edward B. Rodie. International Textbook Company, Scranton, Pa, 1969. 513 p.

Descriptors: "Water supply, "Waste disposal, "Sanitary engineering, "Design, "Operations, "Industrial wastes, "Waste water treatment.

This volume presents the theory and practices relating to the interrelationship between the basic problems of water supply and waste disposal. The authors provide an integrated treatment of the fun-damentals common to both of these areas of sanitary engineering. Detailed are the design and operation of systems for water supply and waste disp Problems in water supply balased by over-populacreated to increased amounts of industrial waste products are described, and some solutions are proposed. The first time chapters concern basic principles of water supply and waste disposal including water use and sewerage volume piping for water and sewage systems, and the collection and storage of water. The last fourteen chapters relate to either problems or solutions such as: water treatment by screening and sedimentation; control of corrosiveness, taste, and odor; sludge treatment and disposal: filtration and disinfection of water, removal of dissolved minerals from water; the ac-tivated sheige process; and primary and secondary sewage treatment. (See also W71-06880 thru W71-

WT1-06879

THE WATER-SEWAGE CYCLE.

W. A. Hardenbergh, and Edward B. Rodie. In: Water Supply and Waste Disposal, International Textbook Company, Scranton, Pa, Chapter 1, p. 1-7, 1960. 4 fig. 6 ref.

Descriptors "Water supply, "Sewage disposal, "Storm drains, "Sewage treatment, "Water treat-ment, Separation techniques, Identifiers, "Storm sewers.

This chapter enumerates the functions of water supply and sewage disposal systems and discusses terminology, financing, and other elements of each system. A section on storm dramage recommends the provision of separate sewage and stormwater systems when sewage treatment is required. General information on water and sewage treatment is also included in this chapter. (See also UPTERALITIES

WITTLOARED

QUANTITY OF WATER FROM RAINFALL,

W. A. Hardenbergh, and Edward B. Rodie.

In: Water Supply and Waste Disposal, International Textbook Company, Scranton, Pa. Chapter 2, p.8-39, 1960, 13 fig. 6 tab. 11 ref.

Descriptors: *Rainfall, *Snowfall, *Runoff, *Streamflow, *Measurement, *Water yield, *Surface waters, *Water quality, *Rainfall disposition. "Steem drains, "Design, "Rational formula, "Ru-meff forecasting, Groundwater, Percolation, Evaporation, Absorption.

The first three sections of this chapter involve rainfall and snowfall, rain measurement, and rain making. Next, runoff is described with a method for measuring streamflow. Other sections discuss the estimation of watershed vield, empirical formulas for runoff of water supply, an investigation of the source for yield, and the quality of surface water. Rainfall-runoff proportions, along with rainfall rate and duration, are cited as important criteria for designing storm drainage facilities. Techniques for computing these three elements are given including the Rational Method and the Burkli Zeiger empirical formula for determining runoff. Other topics treated in the chapter include: percolation and absorption, evaporation, and groundwater. (See also W71-06879) W'71-06881

HYDRAULICS OF WATER AND SEWER CON-

W. A. Hardenbergh, and Edward B. Rodie.

In: Water Supply and Waste Disposal, International Textbook Company, Scranton, Pa, Chapter 4, p 59-72, 1960. 5 tab, 3 fig, 2 ref.

Group 5G-Water Quality Control

Descriptors: *Pipe flow, *Pipes Mannings equation, Hydrualic design. *Pines. *Sewers. Identifiers: *Sewer hydraulics.

General formulas describing the flow of water in pipes are used to compute pipe sizes. Such formulas and other aspects of flow in water pipes are presented in this chapter. Flow in sewers is described specifically with reference to the Manning Formula and other formulas. Additional topics discussed are: limiting velocities in sewers, and the design of full and partly filled sewers ex-cluding circular sewers. (See also W71-06879) W71-06882

PIPING FOR WATER AND SEWER SYSTEMS,

W. A. Hardenbergh, and Edward B. Rodie. In: Water Supply and Waste Disposal, International Textbook Company, Scranton, Pa, Chapter 5, p 73-98, 1960. 22 fig, 3 tab, 10 ref.

Descriptors: *Water supply, *Construction, *Construction materials, *Sewers, Design, Piping struction materials, systems (Mechanical). Identifiers: Pipe construction.

Requirements for the construction of water supply and sewer pipes are listed, and descriptions of the most commonly-used materials are included. Castiron, asbestos-cement, concrete, and steel are discussed in terms of their use in water supply pipe construction. Vitrified-clay, concrete, and asbestos-cement are described for sewer pipes. Other topics in this chapter are: service pipes, electrolysis, water hammer, the thickness of metal pipe, appurtenances for water systems (valves, meters, hydrants) and for sewers (manholes, drop manholes, inlets, catch basins, flush tanks, diverting weirs, inverted siphons, and outlets), junctions of large sewers, loads on pipes in trenches, and the testing of sewer pipe strength. (See also W71-06879) W71-06883

COLLECTION AND TRANSPORTATION OF SEWAGE,

W. A. Hardenbergh, and Edward B. Rodie. In: Water Supply and Waste Disposal, International Textbook Company, Scranton, Pa, Chapter 8, p 161-190, 1960. 3 tab, 8 fig, 4 ref.

Descriptors: *Sewerage, *Sewers, *Storm drains, *Design standards, *Specifications, Runoff, Time of concentration, Construction, Measurement. Identifiers: *Storm sewers, *Capacity, Combined sewers, Curved sewers.

Subjects discussed in this chapter include: the layout of a sewerage system, the position of the sewer in the street, the procedure for establishing layout, and the design of sanitary sewers. Also described is the design of a storm drainage system including information of the inlet time or time of concentration, runoff, sizes and gradients of storm sewers, and inlet capacity. Combined sewers, noted to be rarely-built, follow the same design as that for storm sewers although their shape may be modified. Sewer construction, infiltration measurement, records, and curved sewers are additional topics explored. (See also W71-06879) W71-06884

THE UNABATED GROWTH OF WATER POL-LUTION ABATEMENT ACTIVITIES, For primary bibliographic entry see Field 05D. W71-06889

A DYER'S 'OPERATION CLEANUP', S. M. Suchecki.

Textile Industries, Vol 130, No 6, p 113-122, p 136 and p 175, 1966. 1 fig.

Descriptors: Biochemical oxygen demand, *Water pollution control, New Jersey, Legal aspects. Identifiers: *Dyehouse wastes, Washington (NJ).

In February 1966 the State of New Jersey Department of Health issued an order against the Northern Dyeing Company of Washington, New Jersey, requiring that the firm cease pollution prior to June 1, 1966. The history of this plant and its problems and efforts relative to water pollution are traced. The matter of pollution has become the subject of controversy in the area. The company has taken action but it is concluded that more rainfall would be helpful. (Livengood-North Carolina W71-06891

DETROIT'S METROPOLITAN WATER POLLU-TION CONTROL PROGRAM - IN ACTION, Gerald J. Remus.

The Engineer and the City, p 91-96, 1969.

Descriptors: Water pollution control, *Cities, Project planning, Multiple-purpose projects, *Sewerage, *Storm runoff, *Control systems, *Sewage disposal, Estimated costs, *Construction costs, Instrumentation, Waste water treatment. Identifiers: *Detroit, *Combined sewers.

The adoption of metropolitan programs for water supply, pollution control, and sewage treatment in the Detroit area received its impetus in 1959. A brief review of the growing acceptance of the programs is given. The sewage system for Detroit operates on a combined stormwater-sanitary sewage basis with the use of remote controls, automatic alarms, and computer recordings (including records on how a storm crosses a metropolitan area). The stormflow dirt deposit to the Detroit River has been reduced by at least 15%: and because of the sewer control instruments flooding of the activated sludge process at the plant. Approximately \$371 million will be spent from 1966 to 1975 on this water pollution control program. Recommendations for further studies and programs are made by the author, and an estimated cost list on the sewage disposal construction (1968-1970) is given. W71-06892

DEVELOPMENTS IN STORM AND COMBINED SEWER POLLUTION CONTROL,

William A. Rosenkranz.

Paper presented at the Spring Meeting of the New England Water Pollution Control Association, Jun

Descriptors: *Water pollution control, *Sewage treatment, Application methods, Waste water treatment.

Identifiers: *Stormwater pollution, *Combined sewage, Sewer separation, Storm sewers.

Three basic approaches used to minimize combined sewage or stormwater pollution are defined as: (1) control, (2) treatment, and (3) combinations of the two. Examples are given under each category. Considering progress thus far, it is unlikely that any single control or treatment method developed will successfully solve combined sewer or stormwater pollution problems. Instead, methods providing whole or partial solutions based on particular circumstances of the area will be integrated into the combined sewer or stormwater project. Methods of control and/or treatment described include: screening, disinfection, sedimentation, in-system storage, off-system storage, chemical treatment, automated regulators, and sewer separation. Sewer separation continues to maintain the widest amount of present and planned use and predicted applicability. W71-06893

NEW INFORMATION NEEDS FOR WATER MANAGEMENT IN URBAN REGIONS,

Paper presented at the Am Geophys Union - 1969 National Fall Meeting.

Descriptors: *Water management (Applied), Investigations, *Michigan, Pollutants, Planning, *Regions, Water pollution control, *Cities, Urbaniza-

Identifiers: *Urban water resource management.

To illustrate the new information needs for water management in urban areas, a case study of a waste water management plan is described and the types of data required in the formulation of the plan are identified. Muskegon County, Michigan, is the study area. The basic management concept set forth in the research creates new information needs. The concept is one of utilizing pollutants as resources out of place and, thus, converting them into economic goods. This goal is accomplished by taking the waste from the water, processing it, and putting it on the land, where it becomes useful and valuable. The environmental implications and the data needs for such a program can be viewed readily in the context of this new type of urban water resource management. It is obvious that adjustments in mapping techniques will be necessary to accommodate future management efforts.

GOVERNOR'S CONFERENCE ON WATER RESOURCES MANAGEMENT IN WISCONSIN. For primary bibliographic entry see Field 06E. W71-06910

FEDERAL LEGISLATION-WATER QUALITY AND WATER RESOURCES--IMPACT WISCONSIN.

Wisconsin Univ., Madison, Water Resources

For primary bibliographic entry see Field 06E. W71-06911

STATEMENT OF ASSEMBLYMAN GEORGE M

For primary bibliographic entry see Field 06E. W71-06913

WATER LEGISLATION IN THE 90TH CON-

League of Women Voters, Washington, D.C. For primary bibliographic entry see Field 06E. W71-06914

WATER: INDUSTRY CHALLENGE - TODAY, S. M. Suckecki.

Textile Industries, Vol 130, No 6, p 108-110, 1966.

Descriptors: Water quality, Legal, *Water quality act, Industrial wastes, *Water pollution. Identifiers: Textile mill wastes.

The Water Quality Act of 1965 is the basis of federal water quality standards. The current (1966) daily consumption of water is about 355 billion gallons, of which about 160 billion is used by industry. In 1980 it is estimated these figures will reach 600-650 and 395, respectively. The textile industry requires large amounts of water, and several organizations such as the American Associaton of Colorists and Chemists are supplying information to the industry. (Livengood-North Carolina State) W71-06915

MANUAL OF INDIVIDUAL WATER SUPPLY SYSTEMS.

Department of Health, Education, and Welfare, Washington, D.C.; and Public Health Service, Washington, D.C.

For primary bibliographic entry see Field 05F. W71-06959

CHICAGO SANITARY DISTRICT IN NEW POL-LUTION FIGHT.

Civil Eng, Vol 37, No 10, p 98, Oct 1967.

Techniques of Planning—Group 6A

Descriptors: *Tunnel construction, *Storm runoff. *Sewage, *Tunnels.

Identifiers: *Chicago, Illinois.

As part of Metropolitan Chicago's ten-year program to combat water pollution, a deep tunnel sewage plant is being proposed for completion by 1972 to store excess floodwaters from severe rainstorms in underground chambers. Stormwater runoff will be prevented from entering sanitary sewers, and the water will later be released under controlled conditions. The estimated cost of the deep tunnel project is \$750 million, which is much less than the \$3-billion it would cost to construct separate storm and sanitary sewage systems. Other proposed programs include chlorination of all facilities by 1968, elimination of visible solids by 1969, and construction of a tertiary waste-treatment plant in Hanover, Ill. by 1971.

W71-06971

SEWER MOLE TRIMS COST OF TUNNEL RIBS AND CONCRETE.

For primary bibliographic entry see Field 08H.

PAVED WAY FOR TRANSOONA'S LONG HOLE.

For primary bibliographic entry see Field 08H. W71-06976

DEEP TUNNEL STORAGE MAY SOLVE CITY STORM WATER PROBLEM.

Environ Scie Technol, Vol 3, No 3, p 209-211, Mar

Descriptors: *Storm runoff, *Pollution abatement, *Sewage treatment, *Runoff, *Cost comparisons, *Cost analysis, *Water quality, Overflow, Biochemical oxygen demand.

Identifiers: *Deep tunnel plan, *Chicago, Combined sewers.

The Metropolitan Sanitary District of Greater Chicago (MSD) has a plan devised for the control of pollution from storm and combined sewer water runoff--the Chicagoland Deep Tunnel Project. This plan would: capture flow from a 300 square-mile section; cost approximately \$1.02 billion (\$.02 bilsection; cost approximately \$1.02 billion (\$.02 billion more than the present sewage treatment facilities' cost); and, almost completely remove BOD from the stormwater runoff at 1/4 the cost of available alternatives. The Harza Engineering Co. and Bauer Engineering Inc. are the two consulting firms working on the project which may develop into a \$2.2 billion water quality program. Com-ments by Vinton Bacon, general manager of the sanitary district, are made on the urgency of the project, the necessary reasons for the project, and the benefits from the project. A cost list is given as well as a short description of the tunnel system layout. W71-06981

MODERN TUNNELING METHODS USED ON BOLTON SEWER.

For primary bibliographic entry see Field 08H. W71-06982

LASER BEAM ON MOLE SPEEDS SEWER

For primary bibliographic entry see Field 08H. W71-06986

SILICATE TREATMENT FOR ACID MAIN DRAINAGE PREVENTION, SILICATE AND ALUMINA/SILICA GEL TREATMENT OF

COAL REFUSE FOR THE PREVENTION OF ACID MINE DRAINAGE.

Tyco Labs., Inc., Waltham, Mass.
For primary bibliographic entry see Field 05D. W71-07052

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

EFFICIENCY OF HYDROLOGIC DATA COL-LECTION SYSTEMS, ROLE OF TYPE I AND II

Arizona Univ., Tucson. Dept. of Systems Engineer-

For primary bibliographic entry see Field 07A. W71-06576

EFFICIENCY OF PARAMETER AND STATE ESTIMATION METHODS IN RELATION TO MODELS OF LUMPED AND DISTRIBUTED HYDROLOGIC SYSTEMS,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

For primary bibliographic entry see Field 07A. W71-06577

ERROR ANALYSIS AND SYSTEM IDENTIFI-CATION OF WATER BALANCE AND THE RAINFALL EXCESS COMPONENT IN REAL AND MODEL WATERSHEDS,
Arizona Univ., Tucson. Dept. of Hydrology and

Water Resources.

Chester C. Kisiel, Hasan K. Oashu, and James J. Rogers.

Research Report, Presented at Fall National Meeting of the American Geophysical Union, San Francisco, California, December 7-10, 1970. 28 p, 1 fig, 26 ref. OWRR Project B-007-ARIZ (9).

tionships, *Hydrologic budget, *Estimating, *Time, *Decision making, Flood control, Water yield, Sampling.

Identifiers: *Error analysis, *Bayesian theory,

For purposes of estimating water balance and flood hydrographs in determination of the water yield or rainfall excess component classical methods were reviewed in the light of recent developments in parameter estimation theory (including the theory for unscrambling of observed time series) and decision theory. Theoretical and practical aspects of budget equations as used in the analysis of discrete events (such as a single rainfall-runoff pairs over a period of hours or days) and in the analysis of hydrologic budgets over much larger time units such as a month and year were also reviewed. Considered were measurement and sampling errors and time-dependency in a scientific and decision framework, and the effects of noisy instruments and sampling variability in space and time as a function of physically-meaningful parameters. Error propagation was discussed in terms of reliability of water yield estimates. The Bayesian framework which addresses itself to the 'best' action, design, or decision in the face of overestimation and underestimation errors around an unknown true value estimate was cited as a possible resolution to small sample estimation error. (See also W71-06576) (Kriss-Cornell) W71-06578

SYSTEMS THEORY: A NEW APPROACH FOR MODELLING WATERSHEDS REALISTI-

CALLY, Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

James J. Rogers, Hasan K. Qashu, and Chester C. Kisiel.

Research Report, December 1970. 9 p, 1 fig, 12 ref. OWRR Project B-007-ARIZ (10).

Descriptors: *Mathematical models, *Watersheds (Basins), *Systems analysis, *Hydrologic aspects, Input-output analysis, Time, Equations.

The purpose of this paper was to discuss model description in terms of mathematical systems theory which subsumes the classes of models represented by the theory of differential equations and by sequential machines. Six items which and by sequential machines. Six terms were describe a model according to systems theory were discussed as to their roles in hydrologic modeling. They included: (1) a set of possible inputs such as climatic inputs, model parameters, and physical constants which are required inputs, (2) a time scale, either continuous or discrete, (3) a set of admissible input functions to define the way inputs are organized in time, (4) a set of states determined by examining equations and listing those variables needed to perform all calculations, (5) a state transition function to compute the state of the system at time t given and input function and the initial state which determines (6) the behavior of the system. It was believed that systems theory will provide a unifying theoretical approach to problems of system modeling in hydrology. (See also W71-06576) (Kriss-Cornell)

EXPERIMENTAL PROGRAM FOR ANALYSIS AND VALIDATION OF WATERSHED MODELS, Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

Hasan K. Qashu, James J. Rogers, and Chester C.

Research Report, Presented at the National Winter Meeting of AGU, San Francisco, December 7-10, 1970. 10 p, 6 fig. OWRR Project B-007-ARIZ

Descriptors: *Mathematical models, *Computer programming, *Hydrologic data, *Optimization, *Meteorological data, *Watersheds (Basins), Water balance, Rainfall simulators, Data collec-

Identifiers: *Field data.

An experimental program for measuring spatial and temporal variabilities of the elements of water and energy balances was proposed in order to attain the ultimate objective of hydrologic modeling-to predict interactions and outputs of water from the system with known certainty. The discussion was restricted to description of methods used in acquisition of field data. Standard meteorological instruments used included 2 types of rain gages, evaporation pan, net radiometers, heat flow discs, thermistor and diode-type temperature sensors, black and white pyranometers, and psychrometers. Modified sensors and equipment developed included: transducer assemblage, rainfall simulator, and surface delimitors. A data acquisition system capable of varying scanning rates, frequencies of scanning and input signal controls was used to record data on magnetic tape. Rainfall, interception, temperature, radiation, humidity, and changes in soil water storage were monitored with regulated frequencies. The derived mathematical model was developed to allow for simulation of abiotic-biotic interactions in the system. The area was decomposed into subsystems according to soil, vegetative cover, micromorphology, and topographic condi-tions. The program seemed to provide an effective tool for acquisition of data needed for the development of a physical model. (See also W71-06576) (Kriss-Cornell) W71-06580

A SIMULATION OF IRRIGATION SYSTEMS-THE EFFECT OF WATER SUPPLY AND OPERATING RULES ON PRODUCTION AND INCOME ON IRRIGATED FARMS,

Economic Research Service, Fort Collins, Colo. Natural Resource Economics Div.

Raymond L. Anderson, and Arthur Maass. Technical Bulletin No 1431, January 1971. 57 p, 9 fig, 12 tab, 3 append, 28 ref.

Descriptors: *Digital computers, *Systems analysis, *Simulation analysis, *Water resources development, *Water supply, *Irrigation systems, Decision making, Crop production, Income.

Field 06-WATER RESOURCES PLANNING

Group 6A-Techniques of Planning

The use of a digital computer model of irrigation systems, designed to permit examination of the effects of varying water supply restrictions, water delivery rules, and crop patterns on crop production and farm income in an irrigated area, was described and illustrated. The main objective was to develop and test procedures by which operators and builders of irrigation systems can evaluate and compare alternative methods of distributing water among farmers. The model simulated decision making at several levels of activity in an irrigation system and took into account the responses of different crops to irrigation water. Different decision making activities were assigned to 10 principal phases or subroutines in the general program. Two special subroutines were developed: the first (PLAN) determined the optimum crop pattern in response to a predicted water supply; and the second (REPLAN) reordered farm crop patterns and watering sequences if a water supply became severly short at any time during the season. A third subroutine (TRACE) called for a printout of some of the information used internally in selecting crop watering sequences. Use of the model was illustrated by applying it to a problem involving six farms irrigating six different crops, and receiving different proportions of a total available water supply during 14 intervals in an irrigation season. Results showed the impact on irrigated agriculture of variations in water supply over the season and the importance of the operating procedure used to distribute water. (Kriss-Cornell) W71-06581

STOCHASTIC DYNAMIC PROGRAMMING FOR OPTIMUM RESERVOIR OPERATION, Texas Univ., Austin, Center for Research in Water

Resources.

For primary bibliographic entry see Field 04A.

OPTIMIZATION IN DESIGN OF HYDRAULIC NETWORK.

Bengal Engineering Coll., Howrah (India). Dept. of

Civil Engineering.
Arun K. Deb, and Asok K. Sarkar.

Journal of the Sanitary Engineering Division, ASCE, Vol 97, No SA 2, p 141-159, April 1971. 19 p, 9 fig, 12 ref, 2 append.

Descriptors: *Optimization, *Hydraulic systems, *Network design, *Digital computers, *Mathematical models, *Pipelines, Economics, Costs, Head loss, Pressure head, Water distribution (Ap-

Identifiers: *Equivalent diameters.

An equivalent diameter method for the economical analysis of a pipe network incorporating various cost functions was developed. A relationship between head loss in a pipe and flow through it was given by the Hazen-Williams formula. All branches of network pipes were replaced by equal lengths of equivalent diameter pipes in all loops so that minimum cost was obtained. A correction factor was derived which was algebraically added successively to the assumed flow values resulting in convergence of the assumed flow values towards the solution. A water distribution system consisting of pumps, an overhead service reservoir, and pipe networks was considered for optimization. The effects of the variation of inlet hydraulic head and geometry of the pressure surface on the total cost of the network were studied. The optimal solution was obtained through a digital computer program developed to calculate equivalent diameters and then actual diameters of all pipelines, and total cost of pipelines, the cost of elevated service reservoirs, the initial cost of pumps, and recurring costs using various cost functions. Total cost of a pipe network was dependent on both pressure surface geometry and the inlet pressure head. The cost functions used here were valid for the Calcutta area only but the method could be used in other areas. (Kriss-Cornell) W71-06583

DYNAMIC MODELING OF STREAM QUALITY BY INVARIANT IMBEDDING,

Kansas State Univ., Manhattan. Dept. of Industrial

Engineering. For primary bibliographic entry see Field 05G.

THE EFFECT OF SELECTED HYDROLOGIC VARIABLES ON STREAM SALINITY,

Agricultural Research Service, Chickasha, Okla. H. B. Pionke, and A. D. Nicks.

Bulletin of the International Association of Scientific Hydrology, Vol XV, No 4, p 13-21, December 1971. 9 p, 5 fig, 4 tab, 7 ref.

Descriptors: *Hydrologic aspects, *Stream improvement, *Statistical methods, *Optimization, Streamflow, Watersheds (Basins), Monthly, Precipitation, Agriculture, Rain gages. Identifiers: Antecedent conditions.

A relationship of hydrologic variables with stream salinity was determined statistically for two ephemeral streams, West Bitter Creek and Beaver Creek watershed, located in western Oklahoma. The hydrologic variables employed, composited on a monthly basis, were measures of average streamflow, precipitation, antecedent conditions, and agricultural land use. The statistical methods employed for evaluating the data included simple correlation, multiple regression, factor analysis, and optimization techniques performed by statistical package programs on an electronic computer. For both watersheds, nearly all variables describing the frequency of occurrence and the amount of precipitation were highly correlated with downstream salinity. Among these, the correlation was best for the relationship of maximum daily P with the salinity of West Bitter Creek Conversely, nearly all variables designating location or characteristics of rain gage zone receiving the maximum P for the month were not significantly correlated with stream salinity. The variables describing antecedent conditions except for salinity, did not correlate well with stream salinity. Data from both watersheds were subjected to factor analysis and those variables closely associated with stream salinity were incorporated into multiple regression equations. In comparing the two streams, West Bitter Creek, having the most intensive rain gage network, produced the best prediction equation. (Kriss-Cornell) W71-06588

A DIGITAL MODEL FOR SIMULATING SEDI-MENT MOVEMENT IN A SHALLOW RESER-VOIR.

Corps of Engineers, Davis, Calif. Hydrologic En-

gineering Center. William A. Thomas.

In: Proceedings of a Seminar on Sediment Transport in Rivers and Reservoirs, Corps of Engineers Hydrologic Engineering Center, April 7-9, 1970, Davis, California, Paper No 13, 1970. 10 p, 5 ref, 9 plate, append.

Descriptors: *Mathematical models, *Sediment transport, *Reservoir silting, Computer programs, Bed load, Scour, Suspended load, Deposition (Sediments), Sedimentation, Sediment load, Discharge (Water), Stage discharge relations, Backwater, Profiles.

Identifiers: *Ozark Reservoir (Ark).

The Ozark Reservoir is on the Arkansas River near Ozark, Arkansas. It is about 36 miles long and 45 feet deep at Ozark Dam. During periods of low flow this run-of-river reservoir, which supplies hydroelectric power and depth for navigation, will be contained within the river channel. However, the river will overflow the channel during floods. To determine real estate requirements for the reservoir it is necessary to know the volume of fu-ture sediment deposits, the location of these deposits, and the effect on water surface profiles in the reservoir. A time-sequence digital model was developed to relate the hydraulic characteristics of

flow, the sediment transport capacity and the conservation of material in successive reaches of the reservoir. The order of computations is backwater, sediment transport capacity, volume of sediment in a reach, and resulting bed elevation. In succeeding reaches the depth of deposits at the upstream end is the same as that calculated for the downstream end of the previous reach, and the resulting bed profile is continuous through the reservoir. (See also W71-06675) (Knapp-USGS)

NATURAL RESOURCES PROTECTION STUDY. Metropolitan Council of the Twin Cities, Minn.

Available from NTIS as PB-196 142, \$3.00 in paper copy, \$0.95 in microfiche. Report to The Metropolitan Council of the Twin Cities Area, Nov 1970. 115 p, 61 ref.
Identifiers: *Natural resources, Protection, *Air-

ports, Regional planning, *Regional planning, *Minnesota, Environments, Vulnerability, Water pollution, Groundwater, Surface waters, Soils, Vegetation, Forest land, Air pollution, Fishes, Birds, Zoning.

The study evaluates environmental factors and potential development characteristics to determine actions which are required to protect natural resources. The areas evaluated are the airport development areas for alternate major airport sites at Ham Lake and Rosemount, Minnesota. These areas are studied due to the applicability of regula-tions in conformance with the Minnesota Airport Zoning Act of 1969. However, a universal set of factors has been considered, so that the findings are equally applicable for any area within the region. W71-06780

HYDROLOGIC MODEL OF THE BEAR RIVER BASIN, Utah Water Research Lab., Logan.

For primary bibliographic entry see Field 04A.

6B. Evaluation Process

WATER FOR INDUSTRIAL DEVELOPMENT IN AMITE, FRANKLIN, LINCOLN, PIKE, AND WILKINSON COUNTIES, MISSISSIPPI, Geological Survey, Jackson, Miss. Water Resources Div

For primary bibliographic entry see Field 03E. W71-06510

ALASKA-TEN YEAR COMPREHENSIVE PLAN FOR CLIMATOLOGIC AND HYDROLOGIC DATA.

Available from Alaska Power Admin., P.O. Box 50, Available from Alaska Fower Admin., 1. G. Doxov., Juneau, Alaska 99801. Alaska Inter-agency Technical Committee Report, Third Edition, November 1970. 98 p. 23 map, 20 photo, 18 tab.

Descriptors: *Water resources development, *Long-term planning, *Alaska, *Climatic data, *Hydrologic data, Data collections, Surface waters, Groundwater, Hydrology, Geology, Estuaries, Programs, Project planning, History, Costs, Soils, Soil moisture, Temperature, Precipitation (Atmospheric), Instrumentation, Network design, Streams, Lakes, Aquifers.

Identifiers: Water and climate data system (Alaska).

This report projects needs for water and climate information systems in Alaska during the 1970's, and outlines programs that would fill these needs. The programs concentrate in areas of greatest need--in and near Alaska cities and towns and in the areas of expanding industry and resource extraction. The programs also seek to establish minimum networktype coverage for inventorying and monitoring the water and climate resources. The programs

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respond to an outlook for broad expansion of the Alaska economy and for a substantial population increase in the 1970's. They reflect the new demands accompanying developments in previously remote parts of the state. They reflect the growing concern and need for information about the Alaska environment. Some of the proposals involve substantial program increases. All involve a great deal of original work--data collection and studies that have not been done before. Estimated costs for the proposed programs are summarized. The costs include installation, operation and maintenance for proposed new activities, all on the basis of 1970 prices. (Woodard-USGS) W71-06521

THE POLITICS OF WATER RESOURCE MANAGEMENT THROUGH ARIZONA WATER-RELATED REGULATORY AGENCIES, Arizona Univ., Tucson. Dept. of Government. For primary bibliographic entry see Field 06E. W71-06618

APPRAISAL OF THE WATER AND RELATED LAND RESOURCES OF OKLAHOMA.

Oklahoma Water Resources Board Publication 34. Region 8, March 1971, 141 p.

Descriptors: *Water resources development, *Surwaters, *Groundwater, *Oklahoma. face waters, *Groundwater, *Oklahoma, *Hydrologic data, Planning, Projects, Evaluation, Water supply, Water yield, Water quality, Water utilization, Consumptive use, Hydrogeology, Meteorological data, Climatology, Watershed management, Streams.

Identifiers: *Water resources (Central Oklahoma).

The Oklahoma Water Resources Board, with the assistance of other agencies and individuals, is formulating a long-range comprehensive water plan for Oklahoma. This report (Region VIII) the seventh in a series called 'Appraisal of the Water and Related Land Resources of Oklahoma,' is part of the first step in gathering information basic to this plan for the State's future water prosperity. Region VIII contains not only the geographical center of the State but also a center of population and industry. The Water Resources Council has predicted that within the next 20 years the population of the stream basin system including Region VII will increase by about 36% of the 1970 total, and that personal income in this area will increase 2.5 times over its current rate, primarily as a result of a predicted 36% increase in manufacturing. Extending the Arkansas River Navigation Project up Deep Fork to Arcadia, as has been projected, would enhance the projection for increased industry. In a normal year of 31-inch precipitation, about 2,225,000 acre-feet of runoff is generated in Region VIII. However, only a small percentage of the amount can actually be developed. Suitable dam sites are usually located in areas where water needs are not great. Importing surplus water from outside the basin to meet the growing demand is discussed. (Woodard-USGS) W71-06673

WATER RESEARCH.

For primary bibliographic entry see Field 02A. W71-06759

RESEARCH **PROBLEMS** IN HYDROLOGY AND ENGINEERING, For primary bibliographic entry see Field 02A.

FORT SMITH URBANIZING AREA: WATER, SEWER AND STORM DRAINAGE PLAN, VOLUME I, WATER.

For primary bibliographic entry see Field 04A. W71-06775

ECONOMIC ASPECTS OF OCEAN ACTIVI-TIES. VOLUME II. ECONOMIC FACTORS IN THE DEVELOPMENT OF A COASTAL ZONE, Massachusetts Inst. of Tech., Cambridge,

Available from NTIS as PB-195 224, \$3.00 in paper copy, \$0.95 in microfiche. Report No MSC-71-67, Cambridge, Mass, Sep 70. 183 p, 123 p with

Descriptors: *Coasts, *Nuclear power plants, Beaches, *Urbanization, *Recreation facilities. Planning, Economic feasibility, Cost analysis, Maine government finance.

Identifiers: *Refineries, Urban planning, *Boston harbor.

The core of this Report outlines the economics of the coastal zone in the abstract, defines the concept of economic efficiency, points out the mechanisms by which the private market can fail to allocate the coastal zone efficiently, introduces the concept of parochial benefits, outlines how local control can sometimes operate to produce allocations which are more inefficient than the private market, considers problems introduced by the fact that a decision-making body can almost never predict the future with certainty, and introduces techniques for incorporating this uncertainty into cost-benefit analysis. The practical problems, as well as the limitations, involved in the application of costbenefit analysis to the coastal zone are explored in some detail in four specific examples: (1) The provision of a recreation facility in Boston Harbor; (2) The redevelopment of the coastal town of Hull, Massachusetts; (3) The location of a nuclear power plant near Plymouth, Massachusetts; and (4) The establishment and location of a refinery complex in Maine and the associated oil distribution problem. W71-06776

NATURAL RESOURCES PROTECTION STUDY. Metropolitan Council of the Twin Cities, Minn. For primary bibliographic entry see Field 06A.

AND SEWERAGE FACILITIES PLANNING PROGRAM FOR MADISON, ST. CLAIR AND MONROE COUNTIES, ILLINOIS. PHASE I-PROGRAM DESIGN.

Southwestern Illinois Metropolitan Area Planning Commission, Collinsville,

Available from NTIS as PB-195 456, \$3.00 in paper copy, \$0.95 in microfiche. May 1970. 117 p, 7 fig, 13 ref. HUD Project III 9-275.

Identifiers: *Regional planning, *Illinois, *Water supply, Regional planning, *Sewers, Regional planning, Project planning, Expenses, Financial management, *Madison County (III), *Monroe County (III), *Saint Clair County (III).

Planning goals and objectives; Planning Program design; Administration considerations; Financing considerations; and Construction priorities. W71-06794

CLARKSVILLE-MONTGOMERY COUNTY WATER AND SEWERAGE FACILITIES. COMPREHENSIVE ANALYSIS, PLAN, AND PROGRAM TO 1989, WATER AND SEWER

Clarksville-Montgomery County Regional Planning Commission, Tenn.

For primary bibliographic entry see Field 06D. W71-06802

PROCEEDINGS OF FARM ANIMAL WASTE AND BY-PRODUCT MANAGEMENT CON-FERENCE.

Wisconsin Univ., Madison. For primary bibliographic entry see Field 05G. IMPROVEMENT OF HYDRO-ELECTRIC SCHEMES BY HYDROMECHANICAL IN-HYDRO-ELECTRIC VESTIGATIONS AND SCALE MODEL EXPERI-

Karlsruhe Univ. (West Germany).

E. F. Mosonyi.

Paper DUB/SYMP/EP/B.3, Economic Commission for Europe Committee on Electric Power Symposium on Prospects for Developing Hydro-Electric Schemes and Their Incorporation in Future Energy Supply Systems, Dubrovnik, Yugoslavia, Oct 1970. 13 p, 22 ref.

Descriptors: Project planning, *Hydroelectric power, Hydroelectric powerplants, *Hydroelectric resources, Investigations, Technology, Surge waves, Hydraulic turbines, Pumped storage, Turbine efficiency, Foreign research, Hydraulic machinery, Model studies, Hydraulic design, Research and development, Bibliographies, Operating costs, Cavitation.

Identifiers: German Federal Republic, Hydroelectric power surveys.

Future programs of water power development will utilize less advantageous power sites after the best possible sites have been developed to their fullest extent. Progress in research and technology may open many of the less favorable sites in the future. Some important achievements and trends in technological progress leading to economic development of less favorable hydropower sites are The aspects of improvement by hydromechanical investigations and scale model experiments discussed include: (1) low-head plants, (2) surge control, (3) high-head plants, (4) pumped storage, and (5) improvements in hydrau-lic machinery. Hydromechanical research may be the major contributor to hydroscheme improvements. Theoretical studies, scale model experiments, and field measurements should be investigated for further improvements in hydropower developments. (USBR) W71-06845

NEW INFORMATION NEEDS FOR WATER MANAGEMENT IN URBAN REGIONS. For primary bibliographic entry see Field 05G. W71-06896

CENTRAL NEW YORK REGION WATER RESOURCES: DATA INVENTORY EVALUATION.

Central New York Regional Planning and Development Board, Syracuse.

Available from NTIS as PB-195 008, \$3.00 in paper copy, \$0.95 in microfiche. Technical memo, TM-3, Jan 1970. 16 p. HUD Project No NYP-160. Identifiers: *Regional planning, *New York, *Water resources, Regional planning, Land use, Project planning, Documents.

The report describes the planning efforts, with respect to water resources and related land use of the Central New York Regional Planning and Development Board to January, 1970. Included in the memorandum are a water resources data inventory and an evaluation of the data available. The evaluation section details the organization for water resources planning, the Program for Cooperative Study employed by the River Basin Boards, the progress of this program, and liaison and coordination efforts which are or should be pursued by water resources planners and the Regional Planning Board for their mutual benefit. W71-06939

PILOT-PLANT STUDIES OF PROCESSING WASTES OF COTTON TEXTILES, For primary bibliographic entry see Field 05D. W71-06993

Field 06-WATER RESOURCES PLANNING

Group 6C-Cost Allocation, Cost Sharing, Pricing/Repayment

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

CONCERNING THE ECONOMIC VALUE OF EXPERIMENTATION IN THE DESIGN OF DESALTING PLANTS,

Department of Commerce, Washington, D.C. For primary bibliographic entry see Field 03A. W71-06590

HANDBOOK OF STEEL DRAINAGE CON-STRUCTION PRODUCTS: CHAPTER 15 - COST FACTOR.

For primary bibliographic entry see Field 08A. W71-06644

FINANCING CONSTRUCTION OF A MAJOR DRAINAGE IMPROVEMENT,

For primary bibliographic entry see Field 04A.

EFFECT OF RESEARCH ON PRESENT DRILLING COSTS,

American Association of Oil Well Drilling Contractors, Dallas, Tex.

For primary bibliographic entry see Field 08A. W71-06958

6D. Water Demand

WATER FOR INDUSTRIAL DEVELOPMENT IN AMITE, FRANKLIN, LINCOLN, PIKE, AND WILKINSON COUNTIES, MISSISSIPPI,

Water Geological Survey, Jackson, Miss. Resources Div.

For primary bibliographic entry see Field 03E. W71-06510

A SIMULATION OF IRRIGATION SYSTEMS--THE EFFECT OF WATER SUPPLY AND OPERATING RULES ON PRODUCTION AND INCOME ON IRRIGATED FARMS,

Economic Research Service, Fort Collins, Colo. Natural Resource Economics Div. For primary bibliographic entry see Field 06A.

WATER SUPPLY AND DEMAND, Cornell Univ., Ithaca, N.Y.

L. Michael Falkson.

W71-06581

Available from NTIS as PB-198 306, \$3.00 in paper copy, \$0.95 in microfiche. Technical Report 22, June 1970. 10 p. OWRR Project A-001-NY

Descriptors: *Water supply, *Water demand, *Industrial water, Water shortage, Pricing, Recreation, Statistical methods, *Regions, Water utilization, Water allocation, Irrigation efficiency, Economics.

Identifiers: *Microeconomic analysis, Applied welfare economics.

This is a report concerning some activities and accomplishments at Cornell University through the Water Supply-Demand Project from 1965 to 1969. A brief summary of each year's accomplishments was given. Several new developed courses related to water resources economic were listed. Some of the major research tasks completed by the project were presented. Important research topics in 1966, 67 and 68 included 'The Allocation of Regional Water Supplies: A Case Study of the Northeastern United States,' 'The relationship between water shortages and pricing policies of water supply system,' and some subjects on the demand for water in the fields of irrigation and outdoor recreation. For the fiscal year 1969, the major research activity reported was a statistical analysis of regional variations in industrial water use in the United States to determine if there existed significant regional variations in industrial water use technology as measured by the ratio of water use to value added or water use to value of shipments. A complete description of this analysis made up the bulk of the report. (Wang-Rutgers)
W71-06598

COOLING WATER SOURCES FOR POWER GENERATION,
Westinghouse Electric Corp., East Pittsburgh, Pa.

Power Systems Planning. For primary bibliographic entry see Field 05G. W71-06671

CLARKSVILLE-MONTGOMERY COUNTY WATER AND SEWERAGE FACILITIES. A COMPREHENSIVE ANALYSIS, PLAN, AND PROGRAM TO 1989, WATER AND SEWER STUDY.

Clarksville-Montgomery County Regional Planning Commission, Tenn.

Available from NTIS as PB-195 414, \$3.00 in paper copy, \$0.95 in microfiche. Report to the Clarksville-Montgomery County Regional Planning Commission, Tenn, May 1970. 109 p. HUD Project

Descriptors: *Regional analysis, *Water supply, *Sewers, Financing, Land use, Population, Economic feasibility. Identifiers: *Regional planning, Regional planning,

*Montgomery County, Tennessee, *Clarksville, Tennessee.

The study includes an immediate (5-10 year) and long-range (20-year) water and sewer plan. The area covered is the entire County for water and a 100 square mile urbanizing area, excluding Fort Campbell, for sanitary sewers. Proposals are made for solving immediate problems while indicating needs for the next 20 years.

W71-06802

A STUDY TO EVALUATE POTENTIAL SOLU-TIONS TO THE PROBLEM OF INSURING AN ADEQUATE WATER SUPPLY FOR NEW CASTLE COUNTY, DELAWARE.

University City Science Center, Philadelphia, Pennsylvánia.

For primary bibliographic entry see Field 03B. W71-06933

FUTURE DEMANDS ON GROUNDWATER IN NORTHEASTERN ILLINOIS, Illinois State Water Survey, Urbana.

Richard J. Schicht, and Allen F. Moench. Groundwater, Vol 9, No 2, p 21-28, March-April 1971. 8 p, 7 fig, 3 tab, 11 ref.

Descriptors: *Water demand, *Water resources development, *Groundwater, *Illinois, Water balance, Urbanization, Cities, Withdrawal, Water utilization, Water yield, Recharge, Water sources, Lake Michigan.
Identifiers: *Urban water supply, *Chicago (Il-

Future water demands were estimated for each 10year interval from 1980 to 2020 for areas in the Chicago region dependent upon groundwater as a source of supply. Demands were compared with groundwater availability to define water deficient areas. Two approaches were considered in developing the groundwater resource. The first approach limits groundwater withdrawals to the maximum rate of natural groundwater recharge that can be induced by pumping. The second approach allows withdrawals to exceed natural recharge. When limiting groundwater withdrawals recharge a large part of the region will require importation of water by as early as 1980. With proper pumpage distribution it is conceivable that there is

sufficient water that can be withdrawn (mined) in excess of natural recharge to meet demands through the year 2020. (Knapp-USGS) W71-07004

6E. Water Law and Institutions

LEGAL ASPECTS OF WATER SUPPLY AND WATER QUALITY STORAGE,
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center. For primary bibliographic entry see Field 05G. W71-06506

GUILFORD AND SANGERVILLE WATER DIST V SANGERVILLE WATER SUPPLY CO (POWER OF PUBLIC UTILITIES TO SELL THEIR PROPERTY).

154 A 567-569 (Me 1931).

Descriptors: *Maine, *Contracts, *Remedies, *Public utilities, Public utility districts, Water supply, Water rights, Land tenure, Public rights, Legislation, Judicial decisions, Legal aspects, Administrative agencies, Watercourses (Legal), Reservoirs, Pipes, Conduits, Costs, Eminent

Plaintiff water district sought specific performance of contracts by which defendant water utility companies agreed to sell their works to plaintiff. In one contract the utility's predecessor promised the town or water district, if one was created, that one or the other might acquire the waterworks anytime after installation. In the second contract the legislative charter for the water company provided that the town or water district, if one was created, might purchase ten years after construction. The Supreme Judicial Court of Maine dismissed both bills. In the first contract, the water company had succeeded to the duties under the contract. However, such corporations are quasi-public and may not, without legislative consent, deal with its property in such a way as to incapacitate itself from performing its public duties. The proposal to sell the water system went beyond defendant's corporate power. As to the second contract the legislature, exercising its right to revoke its authorization of sale, amended its original act, enlarging the water district and repealing the provision respect-ing sale and purchase under the contract offer. (Duss-Florida) W71-06526

REUTER V MILAN WATER CO (RIGHT OF WATER COMPANY TO CONDEMN LAND FOR WATER SUPPLY PURPOSES). 198 NE 442-444 (Ind 1935).

Descriptors: *Indiana, *Eminent domain, *Condemnation, *Water supply, Wells, Construction, Lakes, Streams, Subsurface waters, Reservoirs, Cities, Domestic water, Land, Legislation, Judicial decisions, Legal aspects, Right-of-way, Administrative agencies, Public utilities.

Plaintiff water company sought to condemn defendants' lands for the purpose of providing a town's water supply. The projected water supply was to be pumped from beneath defendants' lands. Defendants objected on several grounds, including: (1) that there was no statutory authority giving a private corporation the right of eminent domain, (2) that condemnation of land for the procurement of water where the source was a surface body of water could be distinguished from condemnation of land where the source was underground, and (3) that there was no basis for determining the amount of water to be taken. The trial court overruled defendants' objections and the Supreme Court of Indiana affirmed. A specific legislative act empowers corporations organized and authorized to furnish water to the public or towns to condemn land to carry out such purpose. There is no distinction

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between condemning land with surface water sources and that with subsurface water sources. Determination of the amount of water taken and its value is an issue of fact to be determined upon the report of the appraisers. (Duss-Florida)

ANCONA REALTY CO V FRAZIER (OWNER-SHIP OF ACCRETED ISLAND). 41 SW2d 820-824 (Mo 1931).

Descriptors: *Missouri, *Accretion (Legal aspects), *Legislation, *Land tenure, Real property, Boundaries (Property), Boundary disputes, Islands, State governments, Riparian land, Rivers, Missouri River, Legal aspects, Judicial decisions, Prescriptive rights.

Plaintiff realty company brought action to quiet title to island land claimed by defendant landowner. Defendant asserted that he held title to the disputed land by accretion to his riparian tract, which was also accreted land. By statute, title to all accreted land had been vested in the county; the statute also provided a 20-year moratorium for adverse possession against the county on these accretions. The disputed accretion had occurred during the moratorium. Since plaintiff's tract had been owned by the county at the time of the accretion by virtue of the statute, the Supreme Court of Missouri held that defendant could not have acquired title by accretion. Defendant further asserted title by patent from the county; however, the description of his land did not include the disputed land. The court held that since alluvion or batture with sufficient elevation to be privately owned did not pass with other land unless expressly conveyed in the patent, defendant did not have title by patent. Accordingly, the lower court decision for plaintiff was affirmed. (Hart-Florida)
W71-06554

VAUGHAN V VIRGINIA ELECTRIC AND POWER COMPANY (AUTHORITY TO ISSUE DAM PERMITS FOR NON-HYDROELECTRIC PURPOSES).

178 SE2d 682-684 (Va 1971).

Descriptors: *Virginia, *Dams, *Electric power production, *Watercourses (Legal), Legal aspects, Judicial decisions, Hydroelectric project licensing, Hydroelectric power, Nuclear power plants, Nuclear reactors, Nuclear energy, Cooling water, Cooling, Electric power industry, Electrical networks, Transmission lines, Damsites, Ponding, Rivers, River flow, Land tenure, Real property, Permits, Legislation, Interstate.

Intervening landowners sought to contest the state's grant of a license to dam a river to create a cooling reservoir for a nuclear powerplant. The imcooling reservoir for a nuclear powerplant. In a impounded waters were to be used for cooling purposes only. The intervening landowners contended that the State Corporation Commission was not authorized to issue dam construction permits for non-hydroelectric purposes. The Virginia Supreme Court of Appeals held that the State Corporation Commission was authorized to issue damming permits where the power to be generated by a nuclear plant would flow through interstate transmission lines. Under statutes there were two classes of water: (1) 'water within the state', for which only hydroelectric dam permits could be issued; and (2) hydroelectric dam permits could be issued, and (2) waters of the state', which included waters the damming of which would affect interstate or foreign commerce. The licensing of any dam was authorized for 'waters of the state'. Noting that the nuclear plant would transmit power over interstate lines, the court affirmed the Commission's order is suing the license and conceding a lack of jurisdiction over related property interests. (Earl-Florida)

MOARATTY V TOWN OF HAMPTON (MUNICIPAL LIABILITY FOR STORM DRAIN OVERFLOW). 272 A2d 606-608 (NH 1970).

Descriptors: *New Hampshire, *Local governments, *Flood damage, *Drainage systems, Floods, Floodwater, Legal aspects, Damages, Land tenure, Drains, Drainage effects, Drainage water, Surface waters, Compensation, Judicial decisions, Cities, Storms, Precipitation (Atmospheric), Storm runoff, Cloudbursts, Storm drains, Surface runoff, Intakes, Adjudication procedure.

Plaintiff landowner brought action for property damage resulting from flooding when defendant town's drainage system overflowed. Heavy precipitation preceded the flooding. Plaintiff claimed defendant was negligent in maintaining the system. Defendant asserted that the precipitation was an act of God which overtaxed the system. Defendant asserted that the precipitation was an act of God which overtaxed the system. Defendant asserted that the precipitation was an act of God which overtaxed the system. Defendant asserted that the precipitation was an act of God which overtaxed the system. fendant contested a jury verdict in favor of plaintiff and the trial court's denial of his motions for nonsuit and directed verdict. The Supreme Court of New Hampshire held that a property owner is not entitled to recover for flood damage resulting from drainage system overflow unless the town's negligence in performing maintenance, or the existence of obstructions within the system, is first established. The court ruled that defendant's negligence could not be inferred from the mere fact injury to plaintiff's property. Finding no evidence of either an obstruction within the system or negligence, the court held defendant's motions should have been granted. (Earl-Florida) W71-06584

ARNOLD'S INN, INC V MORGAN (REQUIRED REMOVAL OF OBSTACLES TO RIPARIAN AC-

317 NYS2d 989-991 (Sup Ct 1970).

Descriptors: *New York, *Riparian rights, *Damages, *Access routes, Riparian land, Relative rights, Riparian waters, Navigable waters, State jurisdiction, Real property, Land tenure, Legal aspects, Judicial decisions, Adjudication procedure, Local governments, Right-of-way, Water rights.

Plaintiff riparian owner brought action to compel the removal of rubble and other objects placed on his shoreline by defendant neighboring property owner. Plaintiff contended that such objects restricted his right of access to a navigable tidal bay. Plaintiff failed to establish any damages. De-fendant alleged slander of title. Cross claiming township sought an injunction barring defendant's trespass and requiring him to remove certain struc-tures. Plaintiff and defendant appealed lower court's judgment granting township's cross claim but dismissing plaintiff's claim and defendant's counterclaim. The New York Supreme Court held that a riparian owner is entitled to the removal of obstacles restricting his right of direct access to riparian waters notwithstanding the fact that such riparian owner fails to establish resulting damages. Judgment was affirmed insofar as it related to the township's right to injunctive relief. Judgment was modified in respect to plaintiff's claim, and defendant was directed to remove the objects complained of which restricted his direct access to riparian waters. (Earl-Florida) W71-06589

ROBICHAUX V THERIOT (PROOF OF NAVIGABILITY AS A PREREQUISITE FOR APPLYING ADMIRALTY LAW). 242 So2d 644-646 (La Ct App 1970).

Descriptors: *Louisiana, *Navigation, *Admiralty, *Boating, Boats, Canals, Damages, Recreation, Risks, Adjudication procedure, Navigable waters, Non-navigable waters, Bodies of water, Accidents, Insurance, Legal aspects, Judicial decisions.

Plaintiff boat passenger sought compensation from defendant boat operators and their insurers for injuries sustained in the collision of two pleasure boats. The collision occurred at dusk in the narrow channel of a fifty foot wide canal. No evidence of the canal's navigability was introduced at trial. Plaintiff claimed that the negligent operation of

both boats caused his injuries. The trial court rendered judgment against both defendants. Averring that the canal was navigable, one insurer appealed, contending that the divided damages rule of admiralty prohibited solidary liability judgments. Appellant also contended that the award of \$10,000 damages was excessive. The Louisiana Court of Appeals held that, absent prior proof of navigability, a canal cannot be presumed navigable for purposes of applying the divided damages rule of admiralty law. Finding both operators jointly and of admiraty law. Finding both operators jointly and contributorily negligent, the court affirmed the lower court's solidary judgment against defendants. In light of plaintiff's injuries the award was ruled not excessive. (Earl-Florida) W71-06591

YEOMAN V KANSAS CITY (MUNICIPALITY'S LIABILITY FOR INSTALLATION OF CULVERT AND ALTERING FLOW OF STREAM). 18 SW2d 107-111 (Kansas City Ct App 1929).

Descriptors: *Missouri, *Cities, *Floods, *Overflow, Streams, Culverts, Storm runoff, Storm drains, Surface waters, Surface runoff, Roads, Natural flow doctrine, Alteration of flow, Streamflow, Riparian rights, Surface drainage, Legal aspects, Judicial decisions.

Plaintiff riparian landowner sued defendant municipality for damages resulting from overflow of the creek in front of plaintiff's property. Plaintiff asserted that defendant had negligently installed a culvert and altered the flow of the creek. Before the culvert was installed the creek had never overflowed onto plaintiff's land. Defendant answered that the damage was the result of extraordinary rainfall. At trial, verdict was given for defendant. Plaintiff moved for a new trial, alleging that the verdict was against the weight of the evidence. Although the Kansas City Court of Appeals determined that the evidence failed to show that the culvert ipso facto caused the overflow, it found that the evidence demonstrated that defendant's raising of a street downstream had caused the overflow. In granting plaintiff's motion for a new trial, the court stated that it was no defense for defendant to answer that its actions were a governmental function, performed in good faith. (Hart-Florida) W71-06592

HOGGE V DRAINAGE DIST NO 7 (DRAINAGE DISTRICT'S LIABILITY FOR FLOODING LAND OUTSIDE DISTRICT). 26 SW2d 887-891 (Ark 1930).

*Arkansas, *Drainage districts, Descriptors: *Flooding, *Remedies, Flood damage, Submergence, Overflow, Design flood, Maximum probable flood, Administrative agencies, Eminent domain, Condemnation, Damages, Compensation, Real property, Crops, Drainage, Reservoir, Remedies.

Plaintiff landowner sued defendant drainage district for damages caused by overflow of plaintiff's land. Defendant's construction of a reservoir caused water to overflow plaintiff's land, which was located outside the drainage district. Defendant contended that since plaintiff's property was located outside the district, defendant was not liable. However, the Supreme Court of Arkansas stated five propositions in holding that the lower court improperly sustained defendant's demurrer: (1) obstructing a stream, causing overflow, is a compensable injury; (2) the natural flow of water cannot be changed for the benefit of one class and to the detriment of another without compensation; (3) if a drainage district takes land, compensation must be effected before appropriation; (4) if a district concedes that damage will result from improvements, damages may be assessed by eminent domain proceedings or an action for trespass; and (5) if damages are not conceded, an action for damages may be brought when the improvement is constructed. It makes no difference that damaged property is outside the drainage district whose actions resulted in the injury. Since the demurrer ad-

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mitted plaintiff's allegations, and the injury was permanent, defendant was held liable. (Hart-W71-06593

REID V ROSS (RIPARIAN OWNER SUBJECT TO FISH AND GAME REGULATIONS). 46 SW2d 567-569 (Mo 1932).

Descriptors: *Missouri, *Fishing, *Lakes, *Legislation, State governments, *Missouri River, Navigable rivers, River beds, Riparian land, Riparian rights, Legal aspects, Judicial decisions.

Plaintiff riparian owner sought to enjoin defendant fish and game commissioner from interfering with her fishing rights. A lake had been formed in the river bed when the Missouri River changed its course; part of this lake was owned by plaintiff. Plaintiff seined the lake commercially, and defendant arrested her agents for violation of fish and game law. The applicable statute proclaimed that fishing in 'any of the waters of this state' was unlaw-ful except as permitted by law. However, these restrictions were not applicable to private ponds and artificially propagated fish held in captivity. It was determined that plaintiff's circumstances were not within either of these exceptions. The Supreme Court of Missouri noted that the lake formed in the river bed was private with respect to the riparian fishing right, but that this right was subject to state regulation. Hence, the statute was held to prohibit commercial seining in the lake, and the injunction was denied. (Hart-Florida) W71-06594

WATER AND RELATED LAND RESOURCES STATE ADMINISTRATION, LEGISLATIVE PROCESS AND POLICIES IN MINNESOTA, 1970,

Minnesota Univ., Minneapolis.

William C. Walton, and David L. Hills.

Available from NTIS as PB-198 307, \$3.00 in

paper copy, \$0.95 in microfiche. Bulletin No 27, Jan 1971. 344 p, 19 fig, 18 tab. OWRR Project A-021-MINN (1).

*Minnesota, *Water resources, *Water policy, *Administration, Administrative agencies, Legislation, Water conservation, Water pollution, Water pollution control, Planning, Coordination, Land resources, Natural resources, Con-servation, Environment, Public health, Water rights, Public rights, Federal government, Govern-ment finance, Legal aspects, Water resources development, History, Financing.

The first of a three-part report on water resources administration in Minnesota, this bulletin contains information on state water and related land resources administration, legislative progress, and policies as of 1970. The bulletin initially summarizes the state administrative structure and gives detailed data on the operation of such state agencies as the Department of Conservation, the Pollution Control Agency, the Soil and Water Conservation Commission, the Water Resources Board, the State Board of Health, and the State Planning Agency. It recommends reorganization of state regulatory agencies to better coordinate various agency activities. Included is a reorganization plan consisting of a consolidation of major administrative functions within a single agency, creation of an environmental council and environmental quality commission, and a broadening of the duties of the Minnesota Resources Commission. The bulletin reviews measures relating to water resources introduced in the legislature during the 1969 session. Here it discusses the Minnesota Resources Commission, which serves as a research facility for the legislature. The bulletin ends with a discussion of state water policies and the need for a comprehensive state environmental policy. The National Environmental Policy Act of 1970 is included, as is a list of proposed state legislative actions. (Duss-W71-06599

ENVIRONMENTAL LAW HANDBOOK, For primary bibliographic entry see Field 05G.

PUBLIC LAND POLICY AND THE ENVIRON-MENT, VOLUME 3, PART II: ENVIRONMEN-TAL PROBLEMS ON THE PUBLIC LANDS. CASE STUDIES 9 THROUGH 17, Rocky Mountain Center on Environment, Denver,

Rudolf W. Becking, and G. Lloyd Hayes.

Available from NTIS, AS PB-196 170, \$3.00 in hard copy, \$0.95 in microfiche. Rocky Mountain Center on Environment, Denver, Colorado, December 1970. 837 p, 18 fig, 16 illus, 125 photos, 19 tab, 413 ref, 21 append.

Descriptors: *Public lands, *Land use, *Environmental effects, *Land management, National parks, Pollution abatement, National recreation areas, Water management (Applied), Natural areas, Wafer management (Applied), Natural resources, Federal government, Legislation, Fisheries, Insect control, Wildlife habitats, Diseases, Water quality, Lumber, River basins, Oil, Dams, Recreation demand, Recreation, Highway effects, Transmission lines, Legal aspects.

Nine case studies are included in this volume, each of which discusses public land uses or management practices having environmental consequences. The practices having environmental consequences. The case studies which include data collected and outside materials, discuss: (1) timber, fisheries, and water quality problems in a river basin in Oregon; (2) a review and analysis of four insect-disease control projects; (3) the Santa Barbara oil spill, including the history of oil legislation, judicial decisions, a recounting of events leading to the spill, the spill's environmental impact, the role of the federal government, and suggestions for future legal approaches; (4) the environmental impact of an interstate highway on a wildlife refuge in Alabama; (5) the impact of proposed dams on the Snake River in Idaho; (6) the impact of recreational use on the environment in Minnesota's canoe wilderness of the National Wilderness Preservation System and an appendix of the legal materials involved; (7) the impact of recreational use on the environment in Yosemite National Park; (8) offroad vehicular traffic as a threat to the environment: and (9) aesthetic coordination of transmission lines with the environment. The volume is replete with figures and illustrations and contains 21 appendices documenting the case-study material. (Smiljanich-Florida) W71-06601

THE HUDSON RIVER BASIN.

League of women Voters Education Fund, Washington, DC, \$0.50, 1969. 40 p.

Descriptors: *Hudson River, *River basin development, *Water pollution, *Interstate compacts, River basins, Navigable rivers, River basin commissions, Watersheds (Basins), Interstate commissions, Watershed management, Legal aspects, Bolis, Watershed Hariagenicht, Legar aspects, Delaware River Basin Commission, Pollution abatement, Water pollution control, Water pollution treatment, Water management (Applied).

Land and water use in the Hudson River Basin is the subject of this report. Part I of six parts discusses the 'Challenge on the Hudson', stressing the difficulty of mobilizing an effort to prevent man from destroying nature. In part II, entitled 'Facts and Trends', the upper and lower Hudson basins are examined separately. Part III examines demands on the water and land in six reports dealing with: (1) agriculture; (2) industry; (3) housing; (4) highways; (5) conservation; and (6) water storage. 'Are the Challenges Being Met' is the title of part IV; it examines: (1) the pure waters program; (2) water supply planning; (3) administrative systems for planning and implementation of water policy, including the Delaware River Basin Example and the 'Interstate-Federal Compact for the Hudson'; and (4) the Hudson River Valley Commission. Part V is entitled 'Basin Miniatures' and discusses the Herkimer-Oneida Counties Comprehensive

Planning Program in New York. The final part relates methods of obtaining support for a pollution control project from the local government. (Hart-Florida) W71-06602

LAW OF WATER RESOURCES OF THE STATE OF MISSISSIPPI: A MULTIFACTORAL, POLICY-ORIENTED STUDY OF LEGAL PRESCRIPTIONS RELATING TO WATER USE AND CON-TROL.

Mississippi Water Resources Research Inst., Oxford.

P. Williams, and W. Holder.

Technical Report, Project No 6, June 30, 1966. 23

Descriptors: *Mississippi, *Water resources, *Federal-state water rights conflicts, Water control, Water law, Watercourses (Legal), Artificial watercourses, Natural, Streams, State governments, Mississippi River, Boundaries (Property), Boundary disputes, Water resources development, Legal aspects, United States, Federal government, Regulation, Legislation, Judicial decisions, Water

The objectives of this study were: to determine the problems created by conflicting claims to water use and control in Mississippi; to explore how these conflicting interests have been protected by legislative act, judicial decision, and administrative regulations; and to formulate recommendations for legislation. The research was conducted in three phases, the first phase analyzing legal problems relating to the Mississippi Sound. The Sound was considered important because of conflicting claims of three states and the United States to control its water resources. Delineation of the Mississippi state boundary was necessary to resolve the conflicts. Recommendations to resolve the boundary conflicts and to clarify the authority of the claimants to control the Sound were promulgated. The second phase of the study involved a comprehensive analysis of the law of natural watercourses within Mississippi and included an examination of the legal rights of riparian owners, the status of natural watercourses as boundaries, and problems arising from obstruction of natural watercourses. The final phase examined the law of artificial watercourses, including the right to create and use artificial watercourses, and remedies available to aggrieved parties. (Hart-Florida) W71-06603

PROTECTION AND ENHANCEMENT OF EN-VIRONMENTAL QUALITY. Federal Register, Vol 35, No 46, Saturday, March

7, 1970, p 4247-4248.

Descriptors: *Federal government, *Federal project policy, *Administrative agencies, *Balance of nature, Environment, Institutions, Institutional constraints, Adoption of practices, Coordination, Decision making, Leadership, Legislation, Multi-ple-purpose projects, Project planning, Administration, Administrative decisions, Non-structural alternatives, Integrated control measures, Environmental effects, Ecology

Identifiers: *National Environmental Policy Act of

Measures to be taken by federal agencies and the Council on Environmental Quality in furtherance of the National Environmental Policy Act of 1969 are stipulated in this Order. Heads of agencies shall: (1) moniter and evaluate agency activities to protect environmental quality; (2) insure the adequacy of public information on programs having environmental impact; (3) insure that other governmental bodies and other interested institutions have access to information on environmental problems and control measures; and (4) identify inconsistencies between the National Environmental Protection Act of 1969 and agency jurisdiction, authority, or procedures. The Council on Environmental Quality shall: (1) evaluate and make recom-

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mendations concerning federal policies and programs affecting environmental quality, (2) recommend priorities in environmental programs, (3) conduct hearings and conferences on significant environmental issues, (4) promote the development and use of environmental indexes and monitoring systems, (5) coordinate federal environmental programs, (6) foster research relating to environmental quality, and (7) advise and assist the President and federal agencies on international environmental efforts and in preparing the annual Environmental Quality Report. (Earl-Florida) W71-06604

OUTDOOR RECREATION UNDER FEDERAL POWER ACT.

Federal Register, Vol 35, No 42, p 3993-3994, March 1970. 2 p.

Descriptors: *Administrative agencies, *Recreation, *Regulations, *Federal Power Act, Administrative decisions, Federal government, Federal project policy, Electric power industry, Electric powerplants, Facilities, Recreation facilities, Boat-ing, Swimming, Water sports, Multiple-purpose projects, Safety, Recreation wastes.

The Federal Power Commission clarifies herein a statement of policy respecting outdoor recreational developments at projects licensed or to be licensed under the Federal Power Act. The previous statement of policy is amended to specify that the recreation facilities referred to are those maintained and operated by the licensee, and that the licensee is not expected to be an insurer or guarantor of the safety of visitors, but rather that reasonable measures and facilities be provided to enhance safe use and enjoyment of project lands and waters for recreational purposes. Measures required by the regulation include adequate vertical clearance under bridges and transmission lines, log-booms at spillways and powerhouses, warning systems, buoys, signals, signs, fencing, and sewage facilities. (Hart-Florida)
W71-06605

MORE ABOUT OYSTERS THAN WANTED TO KNOW, VOU

Garrett Power.

Maryland Law Review, Vol 30, No 3, p 199-225, Summer 1970. 27 p, 154 ref.

Descriptors: *Maryland, *Oysters, *Commercial shellfish, *Regulation, Shellfish, Commercial fishing, Fish harvest, State governments, State jurisdiction, Political constraints, Legal aspects, Administration, Political aspects, Conservation, Fish conservation, Bays, Fish populations, Fish management, Economic efficiency, Aquatic productivity, Public rights, Non-structural alternatives, Legislation, Judicial decisions, Relative rights. Identifiers: *Constitutionality.

This article considers: (1) the nature of economic problems occasioned by treating oysters as common property, (2) the response of Maryland's legal institutions, and (3) suggested alternatives to the present treatment. In the author's view, Maryland's attempts to regulate, subsidize, and restore excessively exploited public-oyster grounds have not attained the desired result. Entry restrictions on nonresidents and corporations, and depletion controls governing equipment, minimum oyster size, and seasons appropriate for taking oysters are depicted as discriminatory, economically unproductive, and expensive to enforce. The author suggests and traces past attempts at granting exclusive-use rights to oyster grounds. Recognizing political pressure against the revision of existing laws, the author recommends a broad constitutional attack on the Maryland Oyster Code. Legal precedent attacks on the Code under the equal protection and com-merce clauses are presented. After a successful judicial nullification of existing laws, the author sug-gests a legislative delegation of broad management authority to the Fish and Wildlife Administration. Such a grant of authority would allow the Administration to: (1) determine the most desirable mix between public and private ownership, (2) implement the most technologically efficient oystering methods, and (3) flexibly respond to altered conditions. (Earl-Florida) W71-06606

THE 1958 GENEVA CONVENTION ON THE CONTINENTAL SHELF,

J. A. C. Gutteridge.
In: The British Year Book of International Law 1959, Oxford University Press, Oxford, England, p 102-123, 1960. 75 ref.

Descriptors: *Continental shelf, *International law. *Law of the sea, *Treaties, Aquatic life, International waters, International joint commissions, International commissions, Foreign waters, Interna-

tional Bound and Water Comm., Continental slope, Continental margin, Legal aspects, Commercial fishing, Commercial fish, Commercial shellfish, Natural resources.

Centering on the 1958 Geneva Convention on the Continental Shelf, this article presents an historical analysis of international law concerning continental shelves. Various proposals of signatories to the 1958 Convention are discussed and evaluated. The following subjects are discussed in this article: (1) definition of the continental shelf, (2) nature and extent of the coastal state's rights in the continental shelf, (3) delimitation of the boundary of the continental shelf appurtenant to adjacent states, (4) continental shelf installations, (5) tunneling from terra firma, and (6) the purposes for which a coastal state may exercise sovereign rights over the continental shelf. A coastal state's rights extend to the limit of the territorial sea and beyond to a depth of 200 meters. Coastal states possess sovereign rights to exploit the natural resources of their continental shelf, including sedentary but not swimming species of aquatic life. Installations may be constructed on the continental shelf, and the median line principle is to be used to determine the breadth of the territorial sea. The author concludes that the Convention made a significant contribution to international law even though the breadth of the territorial sea and fishery limits were left unresolved. (Robinson-Florida) W71-06607

WATER RESOURCES--THE INTEREST AND RIGHTS THEREIN OF THE CITIZEN-BENEFICIARY: A DISCUSSION OF NEW YORK LAW, G. David Van Epps.

Syracuse Law Review, Vol 21, No 4, p 1173-1192, Summer 1970, 100 ref.

Descriptors: *New York, *Water rights, *Riparian rights, *Public rights, Water resources, Legislation, Riparian waters, Riparian land, Preferences (Water rights), Water pollution, Water pollution control, Pollution abatement, State governments, Eutrophication, Ecology, Environment, Local government,

The theory that the ultimate impact of the deterioration of water resources is on the quality of life and belongs to the citizenry at large is postulated by this comment. It is suggested that the citizenbeneficiary's interest in water resources should no longer lurk in the background, but be legally recognized and protected. After reviewing various forms of pollution, including eutrophication and some pollution caused by human uses of water, expressions of the citizen-beneficiary's rights are considered. The citizen's riparian, common law, and statutory rights are treated among these rights. While reviewing riparian rights, the author notes that running water is not subject to ownership and that prior appropriation does not apply thereto. The origin of the riparian right from a largely agricultural society is traced. Common law rights, such as the citizen's right to use navigable waters are next reviewed. New York statutory rights of citizens in water resources are considered in detail. The author observes that in recent years the state has been more actively seeking to preserve the citizen interest in waters. He concludes that the citizen-beneficiary's 'patchwork' of water rights is inordinately inflexible to changing society and that more definitive recognition must be afforded the rights of the citizen. (Hart-Florida)

BOUNDARIES ON WATERS.

J. C. Adkins, Jr.
In: Florida Real Estate Law and Procedure, The Harrison Company, Atlanta, Georgia, p 37-48, 1959. 12 p, 35 ref.

Descriptors: *Florida, *Boundaries (Property), *Navigable waters, *Non-navigable waters, Navigation, Ownership of beds, Navigable rivers, Streams, Rivers, Lakes, Boundary disputes, Shores, Tidal waters, High water mark, Low water mark, Tides, Meanders, Riparian rights, Riparian land, Legal aspects, Water law, Land, Land tenure.

Five definitions are used in this article in considering boundaries on waters: (1) the shore is the space between high and low water marks on navigable rivers; (2) uplands are lands bordering on bodies of water; (3) the thread of a stream is the line midway between the opposite shore lines, when the water is at its normal level; (4) tide lands are lands covered and uncovered daily by water through the ebb and flow of normal tides; and (5) seacoast is land adjacent to the sea or ocean. In addition to these definitions, the article covers: (1) history of the law determining water boundaries; (2) navigability of waters; (3) non-navigable waters; (4) navigable waters; (5) artificial waters; (6) meandering waters; and (7) particular calls. The article observes that Florida waters are not considered navigable merely because affected by tides, but must be navigable in fact. It is stated that unless a contrary intention appears, a conveyance of land bounded by water is construed to pass the soil towards the center of the water as far as the grantor owns. Hence, conveyances of land on non-navigable waters pass title to the thread of the stream. Absent a contrary intention, grants of lands bordering on navigable waters carry title to ordinary high water mark. (Hart-Florida)

LEGAL BASES FOR REGIONAL ACTION.

In: River Basin Administration and the Delaware, Syracuse University Press, Syracuse, New York, p 128-148, 1960. 21 p, 43 ref.

Descriptors: *Water resources development, *Interstate compacts, *River basin commissions, *Governments, Legal aspects, Local governments, Federal government, State governments, Interstate commissions, Interstate, Interstate rivers, Delaware River Basin Commission, Legislation, Political aspects, Water management (Applied), Administrative agencies, Administration, Non-structural alternatives.

The legal foundations for planning and managing the water resources of interstate waters are considered in this chapter. One possible source of policy described is an executive committee such as the Delaware River Basin Advisory Committee composed of several governors and mayors; however, the limitations of an executive order are noted. An order: (1) can comprehend interstate areas only at the federal level; (2) is temporary; and (3) is fiscally inadequate. State legislation is the next foundation considered. The author points out that by parallel legislation in adjoining states., interstate management of water resources is feasible. Interstate compacts are also considered as a legal foundation for water resources management. The advantages of the interstate compact are: adequate geographic reach and (2) durability. However, delay in ratification by legislatures is considered a major disadvantage. 'Recent Water Compacts' and 'Federal Work with Compact Agen-

Field 06-WATER RESOURCES PLANNING

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cies' are subtopics examined. The author finds that a federal statute is a prime foundation, since its advantages are: (1) adequate geographic coverage, (2) permanence, and (3) adaptability. The special problem of water allocation is considered in three problem of water anocation is considered in three areas: (1) court decree, (2) federal law and interstate compact, and (3) allocation by administrative agencies. (Hart-Florida)
W71-06610

WATER RIGHTS,

J. C. Adkins, Jr.

In: Rights Incident to Possession of Land, Little, Brown and Company, Boston, p 156-202, 1954. 47

Descriptors: *Water rights, *Streams, *Surface waters, *Groundwater, Appropriation, Natural flow doctrine, Preferences (Water rights), Prescriptive rights, Prior appropriation, Riparian rights, Lakes, Competing uses, Land tenure, Real property, Legal aspects, Reasonable use, Artificial use, Domestic water, Natural use, Relative rights, Riparian land, Drainage, Judicial decisions.

Three main topics are discussed in this chapter dealing with water rights: (1) streams and lakes; (2) surface waters; and (3) diffused groundwaters. In examining streams and lakes, the following areas are considered: (1) riparian rights; (2) the quantitative extent of water rights--natural flow versus reasonable use; (3) the qualitative extent of water rights--domestic versus reasonable commercial uses; (4) the origins, scope and characteristics of appropriation rights; (5) subordination of private rights to public uses; and (6) servitudes for natural stream and flood channels upon riparian lands. Topics discussed with respect to surface waters are: (1) kinds and characteristics of such waters; (2) proprietary rights; (3) rights to obstruct and deflect natural flow; and (4) artificial drainage rights. In relation to diffused surface waters, the following topics are discussed: (1) characteristics of percolating, artesian, and other nontributary groundwaters; (2) proprietary rights; (3) appropriation rights; and (4) interferences with natural flow and purity. (Hart-Florida) W71-06611

CASTING GARBAGE, ETC, INTO WATERS

(CRIMINAL PENALTIES). Va Code Ann sec 62.1-194 (Supp 1970), amending sec 62.1-194 (1968).

Descriptors: *Virginia, *Waste disposal, *Water pollution control, *Environmental sanitation, Baits, Pollutants, Recreation wastes, Crabs, Fish attractants, Water pollution sources, Water resources, Pollution abatement, Non-structural alternatives, Water policy, Regulation, Institutional constraints, Flotsam, Jetsam, Legislation, State governments, Legal aspects, Wastes.

The act of casting, throwing, or dumping solid waste, except fish or crab bait, into state waters is prohibited in this amendment to existing legislation. Such acts are classified as misdemeanors and are punishable by a fine not exceeding one hundred dollars, a jail term not in excess of thirty days, or both. Enforcement authority is vested in all law enforcement officers of the state and its subdivisions. (Earl-Florida) W71-06612

SANITARY DISTRICTS (CREATION,

AUTHORITY, AND POWERS). Va Code Ann secs 21-113, 21-118.4, 21-121 (Supp 1970) amending secs 21-113, 21-118.4, 21-121 (1968).

Descriptors: *Virginia, *Multi-purpose projects. *Sewage districts, *State governments, Local governments, Administration, Administrative agencies, Recreation facilities, Garbage dumps, Jugovernments, Administration, risdiction, Sewerage, Sewage treatment, Eminent domain, Condemnation, Water districts, Legal

aspects, Regulation, Drainage systems, Water supply, Water resources development, Legislation, Sanitary engineering, Waste disposal, Environmen-

The creation and general powers of sanitary districts in Virginia are set forth in this legislation amending an existing statute. The creation of sanitary districts and enlargement of existing districts is authorized by order of a circuit court upon proper application of the voters within a county. The governing boards of such districts are authorized to institute condemnation proceedings for the purpose of constructing water and sewage facilities. Additional powers vested in the governing board by this enactment include the power to: (1) construct, maintain, and operate parking lots, water supply, drainage, sewerage, garbage disposal, heat, light, power, gas, sidewalk, streets, and fire-fighting systems; (2) construct and operate recreational facilities; (3) contract with private or public entities; (4) require owners or tenants of property to connect with systems operated by the district; (5) prescribe and collect charges for the use of sanitary district systems and assert liens where such charges are not paid; (6) employ and compensate necessary personnel; and (7) negotiate for connection of dis-trict systems with existing systems and extensions in areas outside of the district. (Earl-Florida)

UTILITIES--ANTI-POLLUTION PUBLIC REQUIREMENTS.

Session Law Service ch 273, p 700, New Jersey,

Descriptors: *New Jersey, *Public utilities, *Pollution abatement, *Water pollution control, Legislation, Air pollution, Soil contamination, Regulation, Administration, Legal aspects, Utilities, Water works, Electric power industry, Water quality control, Water pollution sources, Power system operations, Public rights, Pollutants, Adoption of Practices, State governments, Standards, Non-struc-tural alternatives.

The rule-making authority of the Board of Public Utility Commissioners is broadened by this amendment allowing the Board to require public utilities to furnish and perform their services in a manner that tends to conserve and preserve the quality of the environment and prevent the pollution of water, air, and land of the state. W71-06614

WETLANDS ACT OF 1970.

NJ Session Law Service ch 272, p 697-699, 1970.

Descriptors: *New Jersey, *Wetlands, *Coastal marshes, *Permits, Legislation, Salt marshes, Tidal marshes, Estuaries, Estuarine environment, Dredging, State governments, Public rights, Balance of nature, Wildlife conservation, Non-structural alternatives, Administration, Administrative agencies, Regulation, Land tenure, Pollution abatement, Riparian land, Riparian rights, Marine fisheries, Shellfish, Legal aspects.

In order to protect New Jersey's coastal wetlands, permits for the dredging, filling, removing, altering, or polluting of such areas are required by this Act. The Commissioner of Environmental Protection shall inventory and map all coastal wetlands within two years of the effective date of the Act and may adopt, modify, or repeal regulations concerning the issuance of permits. In granting, denying, or limiting any permit the Commissioner must consider the effect of the proposed activity upon: (1) the public health and welfare; (2) marine fisheries; (3) shell fisheries; (4) wildlife; (5) the protection of life and property from flood, hurricane, and other natural disasters; and (6) the ecological balance of the estuarine zone. Failure to comply with orders issued pursuant to this Act, or to obtain required permits, is punishable by fine. The Act also provides for: (1) public hearings prior to the promulgation of regulations; (2) notice by publication, in writing,

to affected property owners; (3) the right to judicial review; and (4) the preservation of all existing rights of the state and obligations of riparian owners. (Earl-Florida) W71-06615

WATER QUALITY STANDARDS (INTERSTATE WATERS OF IOWA).
Federal Register, Vol 35, No 92, p 7379-7380, Tuesday, May 12, 1970.

Descriptors: *Iowa, *Water quality, *Interstate rivers, *Water pollution treatment, Administrative agencies, Federal government, Administrative decisions, Waste dilution, Disinfection, Water pudecisions, Waste dilution, Disinfection, Water purification, Phenols, Chemicals, Chemical wastes, Industrial wastes, Water pollution sources, Water distribution (Applied), Water treatment, Waste water treatment, Waste treatment, Thermal pollution, Thermal water.

Identifiers: *Federal Water Pollution Control Act.

Pursuant to the Federal Water Pollution Control Act, the Secretary of the Interior herein establishes water quality standards for certain interstate waters of Iowa. Dilution shall not be a substitute for proper waste treatment. Heat from man-made resources shall not raise the mean daily water tem-perature more than 5 degrees Fahrenheit and shall not exceed a safe temperature for each individual water body; in any case the temperature shall not exceed 90 degrees Fahrenheit. Concentrations of phenols from other than natural sources shall not pnenois from other than natural sources shall not exceed one part per billion. Waters designated as a source of public water supply shall be of such quality that USPHS Drinking Water Standards for finished water can be met after conventional water treatment. No later than December 31, 1937, all municipal and industrial wastes discharged into the Mississippi and Missouri Rivers shall receive a minimum of secondary treatment to achieve a 90% reduction of BOD prior to discharge. Continuous disinfection shall be provided for all municipal waste treatment effluents and other wastes where such wastes are discharged into interstate waters designated for public water supplies or recreational use. (Robinson-Florida) W71-06616

PROTECTION AND CONSERVATION OF WIL-DLIFE.

16 USCA secs 666f thru 666g, 668cc-1 thru 668cc-6 (Supp 1970).

Descriptors: *Legislation, *Wildlife conservation, *Administrative agencies, *Fish conservation, Administrative decisions, Federal government, United States, Wildlife habitats, Balance of nature, Wildlife management, Conservation, Ecology, Hunting, Habitat improvement, Foreign countries.

Certain United States lands are transferred to the administration and control of the Secretary of the Interior by this legislation. The purpose of the act is to provide a program for the conservation, protection, restoration, and propagation of selected species of native fish and wildlife which are threatened with extinction. To accomplish these purposes, the Secretary of the Interior is authorized to acquire land within the area administered. The Secretary is required to coordinate with other agencies and encourage efforts to further the purposes of the act. Importation into the United States of fish or wildlife which is threatened with worldwide extinction is prohibited. Every five years, the Secretary is required to determine which species of fish or wildlife are endangered according to the following factors: (1) impairment of habitat, (2) over-utilization of the habitat for commercial or sporting purposes, (3) disease or predation, or (4) other natural or man-made factors affecting the existence of any species. Civil penalties for violation of the section are limited to \$5000; however, a criminal penalty of \$10,000 or imprisionment for one year may be imposed for willful violation of the act. In addition, the Secretary is required to encourage foreign nations to protect endangered wildlife. (Hart-Florida)

W71-06617

THE POLITICS OF WATER RESOURCE MANAGEMENT THROUGH ARIZONA WATER-RELATED REGULATORY AGENCIES, Arizona Univ., Tucson. Dept. of Government. J. A. Null.

PhD Thesis, 1970. 316 p, 3 fig, 15 tab, 387 ref, 4 append. OWRR Project B-003-ARIZ (13).

Descriptors: *Arizona, *Water users, *Political aspects, *Administrative agencies, State governments, Governments, Administration, Regulation, Water rights, Political constraints, Water resources, Water resources development, Legal aspects, Water utilization, Water demand, Water supply.

Centering on the policy-formulating process in water agencies, this dissertation explains how water regulatory agencies function in Arizona. Legal powers of agencies and their behavior in regard to these powers are compared. The study concludes that administrative laws and procedures are the result of interest group activity against the state administrative bureaucracy. Commercial and mu-nicipal interests are challenging the monopoly of farm-ranch and conservation oriented association influence in water management. There are fourteen agencies with power to regulate the use of water in Arizona; the State Land Department and the Arizona Corporation Commission have the broadest areas of jurisdiction. The author maintains that the state government must assume a vigorous role in water management. The state must solve two problems: (1) revision of water law and (2) administrative reform. The best method of solving these problems is by establishment of a state administrative agency with power to investigate, plan, and coordinate the management of water usage. The author recommends the commission form of administrative agency. He feels that this form of agency would provide broad representation for varied water interests. The author concludes that such a solution is politically feasible. (Robinson-Florida) W71-06618

WATER RESOURCES ON THE PUBLIC LANDS--PLLRC'S SOLUTION TO THE RESERVATION DOCTRINE,

Frank J. Trelease. Land and Water Law Review, Vol 6, No 1, p 89-107, 1970. 35 ref. OWRR Project A-999-WYO (14).

Descriptors: *Reservation doctrine, *Federal reservations, *Federal-state water rights conflicts, *Water supply, Administration, Administrative agencies, Legal aspects, Federal government, State governments, Compensation, Prior appropriation, Water rights, Federal jurisdiction, State jurisdiction, Water demand, Water resources, Water resources development, Water shortage, Planning, Water utilization, Economic impact, Water law.

This article deals with that portion of the Report of the Public Land Law Review Commission pertaining to the reservation doctrine. After a summary of the Report and its recommendations, the following areas are discussed: quantification of the problem, procedures for administrative determination of the reasonableness of quantities claimed, and compensation. The two most important problems to be resolved are the uncertainty engendered by the doctrine and the equity of holders of water rights vested under state law. The Commission recom-mended that the implied reservation doctrine of water rights for federal lands should be clarified in water rights for receral lands should be claimed in four ways: (1) amounts of water claimed should be formally established; (2) procedures for contesting claims should be provided; (3) water requirements for future reservations should be expressly reserved; and (4) compensation should be awarded where interference results with claims valid under state law before the decision in Arizona v. California, 373 U.S. 546 (1963). The author disagrees with the Commission in that he feels a case by case

approach is best for settling disputes in this area, but agrees that water users harmed by exercise of the reservation doctrine should be compensated. The author concludes that the Commission's recommendations should be tried and supported to determine their efficacy. (See also W71-06621 hru W71-06623) (Robinson-Florida) W71-06620

LET THERE BE NO NAGGING DOUBTS: NOR SHALL PRIVATE PROPERTY, INCLUDING WATER RIGHTS, BE TAKEN FOR PUBLIC USE WITHOUT JUST COMPENSATION, Charles E. Corker.

Land and Water Law Review, Vol 6, No 1, p 109-115, 1970, 6 ref.

Descriptors: *Reservation doctrine, *Compensation, *Federal-state water rights conflicts, *Water supply, Federal reservations, Administration, Administrative agencies, Legal aspects, Water law, Federal government, State governments, Prior appropriations, Water rights, Federal jurisdiction, State jurisdiction, Water demand, Water resources, Water resources development, Water shortage, Planning, Water utilization, Economic impact.

The author of this article contends that when the United States exercises the reservation doctrine and utilizes water formerly used by private citizens, it should pay for it. The Public Land Law Review Commission made four proposals dealing with the reservation doctrine: (1) federal agencies should ascertain and given public notice of the projected water requirements for reserved areas for the next forty years; (2) procedures for contesting every claim should be established; (3) future reservations of public lands should be accompanied by a statement of prospective water requirements and an express reservation of such quantity of water; and (4) compensation should be awarded where such reservation results in interference with claims valid under state law prior to Arizona v. California, 373 U.S. 546 (1963). The author contends that it would be impossible to determine the projected water requirements for the next forty years and that it is impractical to attempt to determine prospective water requirements for future reservations of public land. He believes that judges unspecialized in water administration are not equipped to handle water rights cases. The author also feels that there is no valid reason for distinguishing between appropriations of water before and after 1963. (See also W71-06620) (Robinson-Florida) W71-06621

THE IMPLIED RESERVATION DOCTRINE: POLICY OR LAW, John A. Carver, Jr.

Land and Water Law Review, Vol 6, No 1, p 117-122, 1970. 11 ref.

Descriptors: *Reservation doctrine, *Compensation, *Federal-state water rights conflicts, *Water supply, Federal jurisdiction, Federal reservations, Jurisdiction, State jurisdiction, Water rights, Federal government, State governments, Administration, Administration, Administrative agencies, Legal aspects, Water demand, Water resources, Water resources development, Water shortage, Planning, Economic impact, Condemnation value, Water utilization.

Compensation for vested water rights taken by the federal government pursuant to the implied reservation doctrine is evaluated in this article. The author considers that portion of the Report of the Public Land Law Review Commission dealing with the implied reservation doctrine and the judicial background of the doctrine. The author contends that the Commission's proposal that the federal government should determine its water requirements 40 years in advance is impractical. He also feels that a sensible system of water rights ought to include security, and that there should be no uncompensated transfer of water rights from one user to another. Because of the bureaucratic tendency to avoid the charge of having given away federal

rights, the author recommends that Congress provide specific guidelines for compensation. The Commission seems to regard court-made law as less susceptible to congressional amendment than statutory law, but the author concludes that this may be irrelevant, since the Flood Control Act of 1944 provides for compensation for the taking of a water right vested by the laws of the concerned state. (See also W71-06620). (Robinson-Florida) W71-06622

DISCUSSION: WATER RESOURCES.

Land and Water Law Review, Vol 6, No 1, p 123-133, 1970.

Descriptors: *Reservation doctrine, *Federal-state water rights conflicts, *Water supply, *Water resources development, Federal reservations, Compensation, Water rights, Federal government, Developed waters, Planning, Administrative agencies, Legal aspects, Water demand, Water policy, Regulation, Condemnation values, Prior appropriation, Water sources, Water utilization, Water resources, Water requirement, Water users, Judicial decisions.

The oral discussion recorded considers: (1) the background of the Pelton Dam case, (2) the implied reservation doctrine as it affects future use and disposal of public lands, and (3) circumvention of the implied reservation doctrine. According to Mr. Corker the decision in the Pelton Dam case is sound law. Mr Barry contends that the implied reservation doctrine is not a problem and that the United States only owns that water sufficient to carry out the purposes of the reservation, not all that arises on the reservation. He further feels that the federal government intends to compensate people whose vested water rights are taken under the doctrine. Mr Marty states that water is wasted if not used and that certainty should be established to encourage maximum use of water. Mr. Clark maintains that the Pelton Dam case does not involve water rights. Mr. Carmichael disagrees with Mr. Marty's statement that water is wasted if not used. Development by either the industrialist or the farmer will require certainty of water rights according to Mr. Clyde. (See also W71-06620). (Robinson-Florida) W71-06623

CONSERVATION COMMISSIONS IN MASSACHUSETTS: WITH A SUPPLEMENTARY REPORT ON THE EMERGENCE OF CONSERVATION COMMISSIONS IN SIX OTHER NORTHEAST STATES,

Conservation Foundation, Wash., D.C.; and New England Conservation Services Center, Lincoln, Mass.

Andrew J. W. Scheffey, and William J. Duddleson. New England Conservation Services Center, Lincoln, Massachusetts, 1969. 216 p, 15 photo, 1 tab, 1 append.

Descriptors: *Massachusetts, *Conservation, *Organizations, *Local governments, New England, Northeast U.S., Rhode Island, Connecticut, New Hampshire, Maine, New York, New Jersey, Water conservation, Land resources, Water resources development, State governments, Legislation, Administrative agencies, Natural resources, Pollution abatement, Environmental effects, Air polution, History, Social aspects, Political aspects, Legal aspects,

The emergence of local conservation commissions throughout the Northeast is a significant pehnomenon, both as a political development and as an expression of the public's growing concern for environmental quality. A study of the municipal conservation commission concept in Massachusetts, where the movement originated, reveals its successes in the acquisition and protection of open space and wildlife areas, in creating grassroots interest in pollution control, and in acting as a catalyst for conservation action by other local and state agencies and by private interests. The conser-

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vation commission has been tested and found to be a practical local instrument for environmental improvement. The growth of the movement is outlined within a broad historical perspective. The legislative steps that have fostered its growth include self-help acts and a specific Conservation Commission Act. A questionnaire survey of all such commissions in Massachusetts reveals certain principles of effective operation that are beginning to emerge. A supplementary report on the emergence of local conservation commissions in six other Northeast states indicates the growing acceptance of the viability of such commissions in improving the quality of air, land, and water resources development. (Smiljanich-Florida) W71-06624

GEOTHERMAL STEAM ACT OF 1970 (EX-PLOITATION AND DEVELOPMENT OF GEOTHERMAL STEAM RESOURCES). Pub L No 91-581, 84 Stat 1566, 15 US Code Cong and Admin News, p 6778-6788 (1970). 11 p.

Descriptors: *Thermal water, *Steam, *Mineralobescriptors: 'Inermal water, 'Steam, 'Minerato-gy, '*Administration, Administrative agencies, Legislation, Thermal properties, Leases, Permits, Natural resources, Federal government, Water types, Wells, Drilling, Exploration, Exploitation, Mining, Conservation, Energy, Heat, Gases, Oil, Helium, Resource development.

Identifiers: *Geothermal Steam Act, *Geothermal

Authorizing the Secretary of the Interior to make disposition of geothermal steam and associated geothermal resources, the Congress of the United States enacted the Geothermal Steam Act of 1970. The Act defines geothermal steam and associated resources, including: (1) all products of geothermal processes, enbracing indigenous steam, hot water, and brines; (2) similar products resulting from water, gas or other fluids artificially introduced into geothermal formations; (3) heat or other associated energy found in geothermal formations; and (4) any byproduct derived therefrom. The term byproduct is defined as any mineral (exclusive of oil, hydrocarbon gas, or helium) found in geothermal formations which has insufficient value to warrant extraction by itself. The Secretary of the Interior is authorized to issue leases for development and utilization of geothermal steam resources and to formulate regulations governing leases. Leases shall be secured by competitive The Act provides for: (1) maximum acreage of leases per person, (2) royalty payments to the government, (3) duration of leases, (4) termination and adjustment of leases, (5) duties of lessees in the exploration and exploitation of geothermal steam resources, and (6) coexistence with leases under other federal mining acts. The Secretary of the In-terior has broad discretion in formulating regulations to implement the provisions of the Act. (Duss-Florida) W71-06650

PROPOSED LEGISLATION FOR PRESERVING, RESTORING AND IMPROVING WETLANDS FOR MIGRATORY WATERFOWL.

S Rep No 1393, 91st Cong, 2d Sess, 15 US Code Cong and Admin News, p 7110-7117 (1970). 8 p.

Descriptors: *Waterfowl, *Migratory birds, *Wetlands, *Wildlife conservation, Legislation, Marshes, Swamps, Surface waters, Surface runoff, Federal government, Administrative agencies, Land, Contracts, Costs, Water quality, Flood control, Erosion, Land classification, Groundwater, Water pollution, Breeding, Nests. Identifiers: *Water Bank Act.

Recommending passage of a House bill (H.R. 15770) entitled the 'Water Bank Act', which ultimately was enacted as Public Law 91-559, this Senate report discusses the background and need for the bill, gives a section-by-section analysis, and reprints two departmental reports opposing the bill.

The principal objective of the bill is to preserve the habitat of migratory waterfowl by preserving, restoring, and improving wetland areas. The bill is necessary because numerous acres of waterfowl habitat are being lost due to the demands of civilization and because existing legislation providing for acquisition of wetlands by the Department of the Interior has proved inadequate. The bill authorizes the Secretary of Agriculture to enter into ten-year renewable contracts with landowners and operators of important waterfowl areas for conservation of water in wetlands. Various sections describe: (1) the land available for the program, (2) the obligations of those entering into contracts, (3) the method of payment for contracts, (4) contract renewals, (5) termination of contracts, and (6) maximum appropriations during any calendar year. The Departments of Agriculture and Interior opposed the bill on the basis that any program should be administered through the Department of the Interior. (Duss-Florida) W71-06651

REPORT RECOMMENDING SENATE PASSAGE OF A FEDERAL ENVIRONMENTAL EDUCATION ACT.

S Rep No 91-1164, 91st Cong, 2d Sess, 13 US Code Cong and Admin News, p 5763-5774 1970. 12 p.

Descriptors: *Environment, *Environmental effects, *Education, *Administration, Administrative agencies, Federal government, Legislation, Ecology, Ecosystems, Resource development, Coordination, Pollution, Oceans, Public health, Schools (Education), Local governments, Government finance, Projects, Technology, Balance of nature, Resources, Rural areas, City planning. Identifiers: *Environmental Education Act.

Recommending passage of a proposed Environ-mental Education Act (which ultimately became Public Law 91-516), this Senate report discusses the legislation under three headings: (1) background and purpose, (2) major provisions of the bill, and (3) a section-by-section analysis. The report initially emphasizes the need to inform the public on matters which concern environmental quality. Quotations by various educators indicate the broad approach that is required in environmental education, and a summation describes it as an integrated process embracing such factors as population, pollution, resource allocation and depletion, conservation, technology, and environmental planning. The major provisions of the bill would: (1) establish an Office of Environmental Education, (2) authorize grants and contracts with governmental and educational institutions for projects and programs in environmental education, (3) give guidelines for the use of funds, (4) create an Advisory Council on Environmental Quality Education, and (5) authorize cooperative efforts among federal agencies to provide technical assistance to various institutions engaged in environmental education. The section-by-section analysis considers each part of the bill and includes criteria for approval of applications for financial assistance and the amount of funding for the program. (Duss-Florida) W71-06662

REORGANIZATION OF EXECUTIVE DEPART-MENTS TO COORDINATE FEDERAL EN-VIRONMENTAL POLICIES.

8 US Code Cong and Admin News, p 2996-3010 (1970). 15 p.

Descriptors: *Administrative agencies, *Federal government, *Environment, *Coordination, Ecology, Environmental effects, Water pollution, Water pollution control, Water quality, Water quality control, Air pollution, Solid wastes, Wildlife, Conservation, Pesticides, Standards, Legislation, Oceans, Atmosphere, Marine fisheries, Weather, Natural resources, Resource development, Exploration, Exploitation.

In an effort to systematically organize the federal government's environmental activities, President Nixon submitted to Congress two reorganization plans for the executive branch. The first establishes an Environmental Protection Agency (EPA), which would pull together into one agency a variety of research, monitoring, standard-setting, and enforcement activities now scattered among several departments and agencies. Among the functions transferred to the EPA are: (1) those carried out through the Federal Water Quality Administration, (2) pesticide studies by the Department of the Interior and other agencies, and (3) activities of the National Air Pollution Control Administration and Bureau of Solid Waste Management. The principal roles and functions of the EPA would be: (1) stanroles and functions of the EFA would be: (1) stain-dards-setting, (2) research, (3) providing assistance to other agencies, and (4) developing environmental policies. The second reorganization plan would create within the Department of Commerce a National Oceanic and Atmospheric Administration (NOAA), which would consolidate federal activities concerning development of sea resources and research into oceanic and atmospheric phenomena. Among the activities taken over by the NOAA will be those of: (1) the Bureau of Commercial Fisheries, (2) the Environmental Services Administration, and (3) the Marine Minerals Technology Center. Additionally, certain activities of the Departments of the Army and Navy would be taken over by the NOAA. (Duss-Florida) W71-06682

PROPOSED FEDERAL FUNDING FOR CON-STRUCTION OF COMMUNITY WATER AND SEWAGE FACILITIES. HR Rep 91-1263, 91st Cong, 2d Sess, 11 US Code Cong and Admin News p 4225-4229 (1970). 5 p, 1

Descriptors: *Sewage treatment, *Sewage disposal, *Financing, *Water pollution, Water pollution control, Sewers, Public health, Legislation, Federal government, Cities, Waste disposal, Sewage, Water pollution sources, Local governments, Coordination, Water quality, Pollution abatement, Administrative agencies, Administration, Political aspects, Government finance.

Recommending passage of a House bill (H.R. 17795 which ultimately became Public Law 91-431) to provide funds for water and sewer facilities, this report by the Committee on Banking and Currency sets out the important aspects of the legislation. Included in the report are: (1) the objectives of the bill, (2) its background, (3) why the bill is needed, (4) the availability of funds for projects in small towns, (5) additional views of the committee, and (6) dissenting views. The bill amends Title VII of the Housing and Urban Development Act of 1965 and would: (1) help finance construction of urgently needed public facilities to provide for the public health and check water pollution, (2) reenact the balance of the authorization for basic water and sewer facilities under the 1965 Act, (3) make an additional one billion dollars available for grants, and (4) extend the time in which a community could qualify for a basic water and sewer facilities grant. The bill is necessary because local communities do not have the resources to provide needed water and sewer facilities. Funds would be available for projects in small communities. Dissenting views on the bill emphasized the lack of available funds to finance the proposed projects. (Duss-Florida) W71-06689

MUNICIPALS WANT NEW CENTRAL BODY FOR WATER AND SEWAGE.

For primary bibliographic entry see Field 05G. W71-06762

MERSEY RA STANDARDS FOR EFFLUENTS. For primary bibliographic entry see Field 05G.

Water Law and Institutions—Group 6E

NEW AND PROPOSED LAWS.

For primary bibliographic entry see Field 05G.

THE RESPONSIBILITY OF TREATMENT PLANT OPERATORS UNDER THE PORTER-COLOGNE WATER QUALITY CONTROL ACT, For primary bibliographic entry see Field 05G.

THE SEWERAGE (SCOTLAND) ACT 1968, For primary bibliographic entry see Field 05G.

PORTER-COLOGNE ACT REVISITED, For primary bibliographic entry see Field 05G. W71-06769

UTILIZATION OF STREAM FOR STORM DRAINAGE.

For primary bibliographic entry see Field 05G.

INTRODUCTION TO FEDERAL, STATE AND LOCAL ACTION PROGRAMS TO SOLVE ANIMAL WASTE DISPOSAL PROBLEMS, Wisconsin Univ., Madison. Dept. of Agricultural

For primary bibliographic entry see Field 05G. W71-06824

WATER RIGHTS LAW CONFERENCE, New England Council of Water Center Directors.

Proceedings, Water Rights Law Conference, Boston, Mass, November 10, 1966. New England Council of Water Center Directors, n.d. 116 p, 1 map, 110 ref. OWRR Project A-999-MASS (1).

Descriptors: *New Hampshire, *New England, *Water rights, *Conferences, Water law, State governments, Federal government, Water pollution, Water pollution control, Water pollution effects, Water pollution sources, Pollution abatement, Water resources development, Natural flow doctrine, Riparian rights, Water Resources Planning Act, Water Resources Research Act, Water Quality Act, Public rights, Water utilization, Alteration of flow, Access routes, Diversion, Repulsion (Legal aspects), Prior appropriation.

The topics covered in these proceedings of the Water Rights Law Conference include: (1) basic concepts of private water rights; (2) public water use rights; (3) federal-state cooperative research in water law and institutions; (4) diversions and al-terations of stream flow; (5) the law relating to ac-cess to public waters in New Hampshire; (6) multiple use and water law; (7) multiple-use problems of water law in New Hampshire; and (8) water-rights laws in New England. In the first presentation such basic terms as navigability, riparian doctrine, prior appropriation, reasonable use doctrine and common enemy rule are covered. At the end of the first presentation is a series of questions from the conference floor, and the answers furnished by the speaker. The discussion of federal-state cooperative water law research notes three needs to solve water problems: (1) research programs; (2) a national water resources agency; and (3) a federal-state pollution control program. The speaker postulates that this need has been satisfied with enactment of the Water Resources Research Act, Water Resources Planning Act, and the Water Quality Act. The speaker analyzes the effect of these acts upon water problems. (See also W71-06902 thru W71-06909) (Hart-Florida) W71-06901

BASIC CONCEPTS IN PRIVATE WATER RIGHTS.

James H. Kendall, and Richard E. Whiting.

In: Proceedings, Water Rights Law Conference, Boston, Mass, November 10, 1966. New England Council of Water Center Directors, n.d., p 5-33. 52

Descriptors: *New England, *Riparian rights, *Prior appropriation, *Water law, Natural flow doctrine, Navigable rivers, Navigation, Navigable waters, Federal govenment, State governments, Alteration of flow, Artificial use, Competing uses, Domestic water, Legal aspects, Natural use, Obstruction to flow, Reasonable use, Riparian waters, Stock water, Water pollution, Waste disposal.

In New England states the riparian doctrine determines the relative rights of individuals to use water flowing in a natural watercourse. It is applied to surface flow of rivers and streams and to un-derground waters in defined watercourses. The riparian doctrine is inapplicable to non-navigable waters. All use of navigable waters is subjected to the federal power over commerce and navigation. the federal power over commerce and navigation. The doctrine of prior appropriatons gives priority of water usage to the chronologically earliest beneficial use. The doctrine of prior appropriation is codified. Each riparian lawful purposes and detain all the streamflow for domestic uses. Downstream riparians have a remedy, if only for nominal damages, when the upstream owner un-reasonably obstructs or detains the streamflow. If the downstream owner fails to sue within the statue of limitations his rights are forfeited. However, in some jurisdictions no cause arises if no harm is done to the lower riparian owner. The stream may be used for discharge of wastes; decisions hold waste discharge is to be tested by the reasonable use doctrine. However, discharge of wastes is subjected to attack on a nuisance theory. (See also W71-06901) (Hart-Florida)

COMMENTS ON PUBLIC WATER USE RIGHTS,

Orlando E. Delogu.
In: Proceedings, Water Rights Law Conference,
Boston, Mass, November 10, 1966. New England
Council of Water Center Directors, n.d., p 34-43.

Descriptors: *Public rights, *Water rights, *Water utilization, *State governments, Navigation, Navigable waters, Water resources, Water resources development, Public benefits, Water law, Legal aspects, Reservation doctrine, State jurisdiction, Federal jurisdiction.

The concept of public use water rights was conceived by Justinian, and Bracton used the theory in his early common law treatises. Navigability is the ultimate test used to determine whether waters are subject to public water use rights. Since the definition of 'navigable' has been expanded to a point where almost all waters can be called navigable, public water use rights are now more prevalent than a common law. The state, as the institutional embodiment of the public, is deemed the trustee of the water rights; hence enforcement of a member's rights must be effected through the state. A state may regulate and control navigable waters by exercise of its plenary sovereign and police powers. States have enlarged the scope of public water use rights by: (1) redefining 'navigable'; (2) building rights by: (1) redefining 'navigable'; (2) building dams and creating lakes; (3) facilitating access to waters by building roads; (4) purchasing and condemning pirvate water rights for public use; and (5) judicial and administrative redefining and narrowing of the concept of reasonable and beneficial use. The public clamor for more and better water necessitated the enlargement of public water use rights. (See also W71-06901) (Hart-Florida) W71-06903

FEDERAL-STATE COOPERATIVE RESEARCH IN WATER LAW AND INSTITUTIONS, Roland R. Renne.

In: Proceedings, Water Rights Law Conference, Boston, Mass, November 10, 1966. New England Council of Water Center Directors, n.d., p 44-54.

Descriptors: *Water Quality Act, *Water Resources Planning Act, *Water Resources Research Act, *Water resources development, Legislation, Federal government, State governments, Water law, Water pollution, water pollution control, Projects, Grants, Research and development.

To solve the nation's major water problems, three vital needs must be met: (1) a coordinated, continuing, scientific water resources research program to increase available supplies and to increase efficiency in water use; (2) a national water resources review office or council for coordinated, continuing, comprehensive planning of water resources development and management for all major river basins, including active participation by the states through a program of grants for water resources planning; and (3) an effective federal-state water pollution control program with authori-ty to establish and enforce water quality standards for preventing further pollution and clearing up existing pollution. The needs have been met by passage of the Water Resources Research Act, the Water Resources Planning Act, and the Water Quality Act. The new cooperative research program has demonstrated great potential strength in helping solve serious water problems. Current federal expenditures supporting water resources research are at \$100 million annually. There are 18 projects funded under the Water Resources Act which deal with water law and institutions. Although the program under the Research Act is only two years old. 2/5 of the states have made excellent progress. (See also W71-06901) (Hart-Florida) for preventing further pollution and clearing up ex-Florida) W71-06904

DIVERSIONS AND ALTERATIONS STREAM FLOW

Robert L. Leonard.

In: Proceedings, Water Rights Law Conference, Boston, Mass, November 10, 1966. New England Council of Water Center Directors, n.d., p 55-66. 1

Descriptors: *Diversion, *Alteration of flow, *Natural flow doctrine, *Relative rights, Reasonable use, Withdrawl, Streamflow, Obstruction to flow, Reservoirs, Irrigation practices, Riparian rights, Water rights, Irrigation programs, Irrigation wells, Pumping plants, Water allocation (Policy), Water distribution (Applied), Industrial water, Cities, Condemnation, Eminent domain, Compensation Conservation Dams tion, Conservation, Dams.

Technological changes and recent drought have resulted in substantial investments in irrigation requipment by farmers, nurserymen, and golf-course operators. Hence, the quantity of water used for irrigation will increase. However, the increases in irrigation have not created unusual controversy over private water rights; where natural flow has been inadequate to supply new needs, the deficit has usually been furnished from storage ponds or high capacity wells. Alterations of stream flow result from releases by hydroelectric plants to meet the demand peaks for electricity. Seasonal releases from water storage conform to seasonal demands for electricity. Since there is a paucity of remaining sources for hydroelectric power in New England, future demand will be met with pumped storage. Industries using large quantities of water generally develop their own supply. Although the water quality may be impaired upon return, flow is not seriously altered. State and municipal entities may condemn land, flowage, and water rights by providing compensation. This condemnation power, with one exception, has been free of any requirement to maintain a minimum flow downstream. In one instance, conservation groups induced lawmakers to require a minimum downstream flow. (See also W71-06901) (Hart-Florida) W71-06905

THE LAW RELATING TO ACCESS TO PUBLIC WATERS IN NEW HAMPSHIRE, A. J. Kalinske.

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In: Proceedings, Water Rights Law Conference, Boston, Mass, November 10, 1966. New England Council of Water Center Directors, n.d., p 67-86.

Descriptors: *New Hampshire, *Access routes, Descriptors: "New Hampshire, "Access foutes, *Right-of-way, *State governments, Local govern-ments, Recreation, Public rights, Water rights, Water utilization, Water law, Legal aspects, Judi-cial decisions, Legislation, Great ponds, Adminis-

Any natural, fresh-water pond in New Hampshire containing more than 10 acres is a 'great pond' and within the class of public waters. Tidewaters are also considered public. By statute, all natural bodies of water of 20 acres are public. Navigable waters are distinguished from public waters by statutory definition. There has been no standard aprogram for providing for access by the public waters; informational signs were not provided, and state agency responsibility has never been clearly defined. With the increased popularity of recreational boating, the inadequacy of access points became acute; consequently, a project has begun to inventory all public waters and eventually rstablish access points. Whether public water rights exist in waters to which access can only be obtained by trespass has not been decided by New Hampshire courts; however, provisions have been made by statute to furnish access to public waters. Local governments may be petitioned to furnish access, and it may be purchased after proper proceedings. Also, a Right-of-Way Board investigates all transactions involving public lands to determine if a right-of-way to public waters should be retained. A Public Access Advisory Board should be established to select access sites to public waters. (See also W71-06901) (Hart-Florida) W71-06906

MULTIPLE USE AND WATER LAW,

F. O. Sargent.

In: Proceedings, Water Rights Law Conference, Boston, Mass, November 10, 1966. New England Council of Water Center Directors, p 87-96. 2 ref.

Descriptors: *New England, *Water law, *Water resources development, *Legislation, State governments, Administrative agencies, Water resources, Beds under waters, Ownership of beds, Stream beds, Riparian rights, Water management (Apbeus, Riparian rights, water management (Applied), Multiple-purpose projects, Non-structural alternatives, Water allocation (Policy), Conjunctive use, Multiple purpose, Optimum development plans, Water pullution, Watersheds (Basins).

The two major bodies of water law--common law and statutory law--are inadequate guides to water resource development. The common law arose in England, where water is plentiful. Although the common law has been modified in America, it has always been inadequate for managing water resources development where water was scarce and multiple uses conflict. Statues governing pollution and water quality are well developed, but other statutory provisions have not been revised, updated, or supplemented to regulate current water resource development problems. The following legislation is necessary: (1) clarifying rights in streambeds; (2) governing minimum streamflow; (3) providing for public access to public waters; (4) describing the procedures to be followed and the state agencies responsible when anyone desires to alter beds under water; (5) revising water management and administration procedures; and (6) providing procedures for water and stream zoning. Furthermore, the multiple-use concept of water requires a river basin approach to water resource law. Four types economic analyses should be made for all major resource development projects: (1) benefit-costs; (2) economic development potential; (3) location theory; and (4) opportunity-cost. (See also W71-06901) (Hart-Florida) W71-06907

MULTIPLE-USE PROBLEMS OF WATER LAW IN NEW HAMPSHIRE. Robert H. Forste.

In: Proceedings, Water Rights Law Conference, Boston, Mass, November 10, 1966. New England Council of Water Center Directors, n.d., p 97-106.

Descriptors: *New Hampshire, *New England, *Multiple purpose, *Public rights, Water rights, Water pollution, Water pollution control, Water utilization, Natural flow doctrine, Riparian rights, Riparian waters, Recreation, Swimming, Dams, Flood control, Sewage, Sewage cisposal, Waste disposal, Legal aspects, Water law, Judicial decisions, Reasonable use, Beneficial use, Water resources, Water distribution (Applied).

Throughout New England conflicts increasing in both number and intensity are occurring in the competition for varied uses of water. The riparian rights doctrine governs water use in New Hampshire; all riparian owners may reasonably use and enjoy the water and have the right to natural flow. Upstream and downstream owners have equal rights. 'Great ponds' in New Hampshire are public waters. Six multiple-use conflicts are: (1) flood control, recreation, and public water supplies; (2) sewage-waste disposal and recreation; (3) powder, recreation, waste disposal, irrigation, and public water supplies; (4) power, pollution and recreation; (5) mineral exploitation and recreation/esthetics; and (6) public water supplies and recreation. The absence in water law of two economic elements is reflected in the inability of case law to deal with external effects and the general absence of a price system to assist in water allocation. Economists should be able to furnish courts and commissions with policy alternatives available in regulating water use. Courts must be willing to accept input from the economist before handling down a 'reaonable use' decision concern-ing water law. (See also W71-06901) (Hart-Florida) W71-06908

WATER RIGHTS LAWS IN NEW ENGLAND: SUMMARY AND OBSERVATIONS,

Harold H. Ellis.

In: Proceedings, Water Rights Law Conference, Boston, Mass, November 10, 1966. New England Council of Water Center Directors, n.d., p 107-115, 1 ref.

Descriptors: *New England, *Water utilization, *Water resources development, *Legislation, Water rights, Riparian rights, Riparian land, Public rights, Access routes, Water allocation (Policy), Water distribution (Applied), Drainage, Water pollution, Water pollution control, Pollution abatement, Floods, Flood control, Obstruction to flow, Dams, Diversions, Eminent domain, Condemnation, Compensation, Prescriptive rights, Legal aspects.

As water-use conflicts increase in quantity and intensity, water rights laws become more important. Neigher common law nor legislation has kept pace with water-use conflicts; hence additional legislation will be necessary to cope with emerging water problems. Some of these emerging problems are: (1) the respective roles of courts, governments and administrative agencies; (2) definitions of riparian rights, riparian land, and permissibility of nonriparian use; (3) private versus public rights, conflicting public uses, and public access problems;
(4) coordination of water allocation and pollution control, water development, drainage or flood control measures; (5) which kinds of pollution control measures to adopt; (6) obstructions to watercourses; (7) uses of zoning, eminent domain, and minimum stream-flow provisions; (8) coordination of rights in or regulation of interconnected sources of water; (9) prescriptive water rights; (10) compatibility of water laws with technical knowledge and innovations concerning the state, multiple use, and development of water resources; (11) certainty and flexibility of water allocation systems; and (12) reliance upon market forces to allocate water resources. Development of proposals for legislative and other methods of alleviating water problems must be facilitated by technicians, lawyers, economists, and public officials. (See also W71-06901) (Hart-Florida) W71-06909

GOVERNOR'S CONFERENCE ON WATER RESOURCES MANAGEMENT IN WISCONSIN.

Available from Wisconsin Water Resources Center, Madison 53706 for \$1.00. Selected Papers and a Summary of the Proceedings of Governor's Conference on Water Resources Management, Madison, October 14 and 15, 1965. University of Wisconsin, Water Resources Center, Madison, March 1966. 76 p.

Descriptors: *Wisconsin, *Water resources development, *Planning, *Water management (Applied), Water resources, Long-term planning, Federal government, State governments, Legislation, Water quality control, New York, Agriculture, Conservation, Industries, Cities, Recreation, Economics, Water requirements, Pollution abatement, Water rights, Legal aspects, Administrative agencies, Supervisory control (Power).

At the request of the Governor of Wisconsin, the Governor's Committee on Water Resources sponsored a conference on water resources management. The purposes of the conference were: (1) to provide the members of the committee with a current picture of the state's water problems and (2) to act as a sounding board for citizens of the state concerned with water resources. Addresses conconcerned with water resources. Addresses contained herein deal with: (1) water resources and Wisconsin' future; (2) water resources planning and development; (3) the impact of federal legislation on Wisconsin's water quality and water resources; (4) a case study of water resources planning in Wisconsin; (5) water resources planning in New York; (6) water resources management in Wisconsin from the viewpoint of particulture consequents in industry, multiplicalities. agriculture, conservation, industry, municipalities, and recreation; (7) the economics of water management, (8) water needs and water resources; (9) water pollution control; (10) water rights and legislation; and (11) conservation and recreation. Suggestions posed by the discussion groups included the need for reorganization of the agencies dealing with water resources, reworking of the statues relating to water use, and reconsideration of the constitutional restriction forbidding works of internal improvement by the state. (See also W71-06911 thru W71-06913) (Smiljanich-Florida) W71-06910

FEDERAL LEGISLATION-WATER QUALITY AND WATER RESOURCES-IMPACT ON WISCONSIN, Wisconsin Univ., Madison. Water Resources

Center

Gerald A Roblich

In: Selected Papers and a Summary of the Proceedings of Governor's Conference on Water Resources Management, Madison, October 14 and 15, 1965. University of Wisconsin, Water Resources Center, Madison, March 1966, p 10-12.

Descriptors: *Wisconsin, *Water Resources Research Act, *Water Resources Planning Act, Research Act, Water Resources Franking Act, *Water Quality Act, Federal government, Administrative agencies, Water resources development, Federal jurisdiction, Federal-state water rights conflicts, State governments, Legislation, Planning, Administration, Research and development, River basin development, Water quality, Water pollution, Eutrophication, Coordination, Industrial wastes, Municipal wastes, Storm drains, Standards, Legal aspects, Water allocation (Pol-

The passage of three federal acts provides an avenue of joint federal-state cooperation in water resource research, planning, and quality control. The Water Resources Research Act makes funds available for the conduct of water resources research in the broad sense. Such funds in Wisconsin are administered by the Water Resources

Water Law and Institutions—Group 6E

Center. The two major areas of research have involved the problem of eutrophication of lakes and that of river basin planning and coordination. The Water Resources Planning Act establishes the Federal Water Resources Council. The Council is to assess the adequacy of regional water supplies in the United States and study the adequacy of administrative and statutory means for the coordination of water resources policies and programs. Wisconsin is particularly interested in that part of the Act which makes funds available to assist in developing comprehensive water resource plans.
The Water Quality Act of 1965 establishes the
Federal Water Pollution Control Administration. The Act recognizes the problems of pollution caused by the discharge of municipal and industrial wastes and storm water sewerage. The Act sets forth procedures relative to the adoption by the states of water-quality criteria applicable to interstate waters. (See also W71-6910) (Smiljanich-Florida) W71-06911

WATER RESOURCES PLANNING IN NEW YORK.

Nelson A. Rockefeller.

In: Selected Papers and a Summary of the Proceedings of Governor's Conference On Water Resources Management, Madison, October 14 and 15, 1965. University of Wisconsin, Water Resource Center, Madison, March 1966, p 18-20.

Descriptors: *New York, *Wisconsin, *Water resources development, *Long term planning, State governments, Federal government, Local governments, Cities, Future planning (Projected), Financing, Cost sharing, Coordination, Estimated costs, Research and development, Administrative agencies, Water management (Applied), Administration, Pollution abatement, Municipal wastes, Industrial wastes, Sewage treatment, Political aspects, Legal aspects.

Based on the New York experience, it is the author's belief that the states have the largest obligation and opportunity for leadership in the field of water resources development. New York reorganized its water resources management agencies under central control. Regional water resources planning and development boards insure grass-roots participation and bring about coordination at the local level of local, state and federal activity. At the same time, the centralizing of state policy making and leadership permits the state to be an effective agent in any cooperative studies with federal and local agencies. The problem of financing pollution abatement has led to the speaker's proposed Pure Waters Program. The goal of this program is to clean up municipal and industrial pollution in the state in six years. The heart of the Program is the state's leadership in a plan whereby local, state, and federal governments share the cost of constructing interceptor sewers and sewage treatment plants. Changes in federal financial assistance are proposed. The centralization of water management at the state level is a key factor in the progress thus far achieved. (See also W71-06910) (Smiljanich-Florida) W71-06912

STATEMENT OF ASSEMBLYMAN GEORGE M BORG, George M. Borg. In: Selected Papers and a Summary of the

Proceedings of Governor's Conference On Water Resources Management, Madison, October 14 and 15, 1965. University of Wisconsin, Water Resources Center, Madison, March 1966, p 68-69.

*Water resources *Wisconsin, development, *Administrative agencies, *Water management (Applied), Legislation, State governments, Local governments, Financing, Cost sharing, Pollution abatement, Municipal wastes, Industrial wastes, Sewage treatment, Legal aspects, Treatment facilities, Research and development, Adoption of practices, Decision making, Institutions, Water policy, Grants, Administrative decisions

Assembly Bill 875, which the author introduced into the Wisconsin State Legislature, would create an independent agency with central authority to consolidate all water-control functions. The new Department of Water Resources would be designed to promote the full utilization and conservation of the state's public waters. The Department and its director would be aided by a nine-man advisory committee representing various interests. The functions of the department would be: (1) to inspect all public water supplies and sewage systems and plants, (2) to approve construction plans for public plants and for control measures in private plants producing wastes, (3) to hold hearings and issue and seek enforcement of orders for the prevention or abatement of water pollution, (4) to sponsor research on the protection of water resources, and (5) to administer state and federal aid for pollution control. A program of state aid to local governments would be established by the Bill. Private industry and public and private agencies would be encouraged to conduct research on the problem of industrial wastes. Funding measures are also provided. (See also W71-06910) (Smiljanich-Florida) W71-06913

WATER LEGISLATION IN THE 90TH CON-

League of Women Voters, Washington, D.C.

Water Resources Current Review No 5, February 1969, 16 p.

Descriptors: *Legislation, *Water resources, *Water resources development, *Federal government, Political aspects, Institutional constraints, Legal aspects, Erosion control, Estuaried, Nuclear powerplants, Desalination plants, Water pollution control, Water quality control, Grants, Apprioriations, Oil wastes, Financing, Pollution abatement, Flood plain insurance, Water policy, Sediment control, Sewage treatment, Ships, Regulation, Nonstructural alternatives.

Identifiers: Scenic Rivers Act, National Water Commission Act, Colorado River Basin Project

The merits, adequacy, and legislative history of water legislation of the 90th Congress are examined in this study. The prospects of future water resource legislation are also considered. Legislation passed by the 90th Congress includes: (1) the Colorado River Basin Project Act, (2) the Scenic Rivers Act, (3) the National Water Commission Act, (4) the flood insurance provision of the 1968 HUD Act, and (5) an Act authorizing an estuarine study. In addition, the Great Lakes Interstate Basin Compact and federal participation in the Bolsa Island nuclear generating and desalinization plant were approved. Despite passage, the Water Quality Improvement Act and the Oil and Hazardous Substances Pollution Act were not reported out of the conference committee due to the opposition of industrial lobbies. Legislation not considered by Congress, but examined by this study includes: (1) the Surface Mining Reclamation Act; (2) bills restricting vessel-sewage, mine-drainage, and lake pollution; and (3) sediment control bills. Included within the 'modest' water-resource appropriations were \$214 million for sewage treatment, \$165 million for water and lateral sewer programs, and \$28 million for rural water and waste programs. (Earl-Florida) W71-06914

AN EVALUATION OF THE PROVISIONS AND POLICIES OF THE OUTER CONTINENTAL SHELF LAND ACT,

Robert B. Krueger. Natural Resources Journal, Vol 10, No 4, p 763-810, October 1970. 48 p, 174 ref.

Descriptors: *Administration, *Continental shelf, *Exploitation, *Leases, Public rights, Administrative agencies, Decision making, Administrative decisions, Regulation, Natural resources, Environ-mental effects, Project planning, Federal government, Continental slope, Continental margins, Institutional constraints, Coasts, Contracts, Offshore platforms, Federal project policy, Land use, Oil fields, Boundaries (Property), Legal aspects,

Identifiers: *Outer Continental Shelf Lands Act.

The second installment of a two-part evaluation, this article examines the administration of the Outer Continental Shelf Lands Act. The policy objective of maximum benefit to the public is the criterion for the author's observations, analysis, and recommendations. This standard is a composite of: (1) efficient resource management, (2) the encouragement of private participation, (3) federal revenue maximization, (4) technological advancement, (5) encouragement of the multiple use of resources, and (6) environmental-quality protection. The article studies mineral leasing and considers: (1) the existing system of selecting areas for lease, (2) a case study of Santa Barbara, (3) new and proposed offshore regulations, (4) hard minerals, and (5) future developments. The author examines lease-sale size and timing determination. The article examines the existing system, alternative forms, and competitive versus non-competitive lease-allocation systems. The author's study includes the administrative determination of: (1) drilling and production requirements, (2) terms and royalties, and (3) entry requirements. An examination of miscellaneous problems encompasses:
(1) boundaries and jurisdiction; (2) real property use; (3) geothermal and fresh water resources; (4) living seabed resources; (5) salvage and treasure recovery; (6) filling, dredging, and dumping; and (7) marine sanctuaries and scientific facilities. Earl-Florida) W71-06916

STATUTES AND REGULATIONS GOVERNING PRIVATE WATER WELL CONSTRUCTION AND PUMP INSTALLATIONS,

Wisconsin State Board of Health, Madison. Well Drilling and Sanitation Services. T. A. Calabresa.

licensing.

Groundwater, Vol 1, No 2, p 25-32, April 1963.

Descriptors: *Wisconsin, *Water wells, *Legal aspects, Drilling, Public health, Legislation, Ordinances, Statutes, Well regulations.
Identifiers: *Driller licensing, *Pump installer

The intent of this paper is to discuss the need for laws and regulations governing construction of wells for private water supplies. This will include: (1) why laws and regulations are necessary, (2) need for registration and licensing of drillers and pump installers, (3) how laws and regulations affect uniformity of construction and the desirability of such uniformity, (4) how they encourage the manufacture of new materials and group organization, (5) what a law and code should contain, (6) of judgment in administering laws and the regulations adopted pursuant thereto, and (7) the difficulties in enforcing laws and regulations including budgetary reasons. The material presented is drawn from Wisconsin's 26 years of private water supply administration and in part from personal experience. Hence, all statements and conclusions made do not necessarily represent the thinking, views or practice of the author's employer. There is a definite need for control over the construction of private water supplies. This can best be accomplished by licensing of drillers and pump installers and the adoption of regulations for the location and construction of wells and the installation of pumps. Such controls will do much to preserve our most precious natural resource, groundwater, and to advance knowledge of the geologic and hydrologic characteristics of aquifers in a state. (Campbell-

W71-06953

Group 6E-Water Law and Institutions

PROSPECTS FOR METROPOLITAN WATER MANAGEMENT,

MANAGEMENT,
American Society of Civil Engineers, Urban Water
Resources Research Council, New York.

M. B. McPherson.

M. B. McPherson.
Copies available from ASCE, 345 E. 47th St., New York, N.Y. 10017, at \$2.00 each. Urban Water Resources Research Council, December, 1970. 192 p, 12 fig, 7 tab, 4 append. OWRR Project C-1536 (No 1992) (5).

Descriptors: *Urban areas, *Water management (Applied), *Institutions of Government, *Adminis-(Applied), *Institutions of Government, *Administrative agencies, Urbanization, Local governments, Cities, Water policy, Water resources development, Social values, Economic efficiency, Public health, Ecology, Environment. Identifiers: *Metropolitan, Water processes, Private corporations, Human biological needs, Roles of science and technology.

The report of a study which attempted to take into account: expectations for the environment of future cities; necessary or desirable new administra-tive arrangements for future public services management; and the expected impact and interacmanagement, and the expected impact and interac-tion of emerging technology, urbanization trends, social goals and related matters. The purpose of the study was to search for ways to make more effec-tive use of technology in the improvement of urban living along with more effective allocation and use of metropolitan total fiscal resources. The objective, background, scope and format of the report comprise the first chapter. The text is summarized in Chapter 2, which also contains the conclusions and recommendations. The latter emphasize and recommendations. The latter emphasize research needs. Coverage can be surmised from the titles of the remaining text chapters - 'Urbanization: Growth, Problems and Trends'; 'Human Biological and Social Needs; The Roles of Science, Private Corporations'; Technology and Private Corporations'; 'Metropolitan Physical and Governmental Structure'; 'Adaptations for Modifying Governmental Structure in the Metropolis'; 'Prospects for Governmental Reorganization in Metropolitan Areas'; 'Contemporary Metropolitan Water Management', and 'Expected Directions in Metropolitan Water Management. There are four appendices. Approximately 250 pages; over 200 references. (McPherson-ASCE). Technology and

AN EXPLORATION OF COMPONENTS AF-FECTING AND LIMITING POLICYMAKING OPTIONS IN LOCAL WATER AGENCIES: PHASE II.

Colorado Univ., Fort Collins. Environmental Resources Center.

Available from National Technical Information Service as PB-198 428, \$3.00 in paper copy, \$0.95 in microfiche. Environmental Resources Center, Colorado State Univ, Fort Collins, Completion Report Series No 22, June 30, 1970. 115 p, 16 fig, 20 tab. OWRR Project B-029-COLO (5).

Descriptors: *Administration, *Constraints, *Decision making, Evaluation, Formulation, Institutional constraints, *Institutions, Local governments, *Methodology, Non-structural Planning, *Rural areas, *Water users. alternatives.

The perceptions, attitudes, orientations, and interaction patterns of water user publics are significant elements in local water systems. In an effort to locate at least one firm parameter of water systems, this research examines the attitudes, interaction, and other behavior of randomized samples of users of five local water agencies. Private and public agencies and rural and urban areas are included in the samples. The findings indicate that traditional, common sense classifications, such as privatepublic dichotomies or socio-economic classifications, have far less effect on public attitudes toward water agencies, than do volume, type, and content of communication. Systematic differences, however, are present between urban and rural users. Rural users tend to exhibit somewhat more positive images of water management and higher levels of satisfaction than do urban users. The data further indicate considerable, but no complete, independence of water systems from more general political systems. The linkages between systems are limited and occur only at selected points. Water system attitudes and behavior, however, are mutually associated in systematic and regular patterns across the samples. Communications about water with one's peers and the water management influence the water system strongly. The manner and form of influence or constraining effect may vary considerably, but a large amount of influence is consistently present. Generally, high peer discussion trafficks negative images of an agency, but images improve with each added increment of contact with management. Essentially, water systems have very low public visibility which impedes their capacity to sustain themselves. W71-07054

6F. Nonstructural Alternatives

FLOOD PLAIN INFORMATION, NORTH BRANCH PENNSAUKEN CREEK, BURLING-TON COUNTY, NEW JERSEY.
Corps of Engineers, Philadelphia, Pa. For primary bibliographic entry see Field 04A. W71-06517

FLOOD PLAIN INFORMATION, BIG COTTON INDIAN, LITTLE COTTON INDIAN, TAR AND PANTHER CREEKS - PART METROPOLITAN ATLANTA, GEORGIA. Corps of Engineers, Savannah, Ga. For primary bibliographic entry see Field 04A. W71-06522

6G. Ecologic Impact of Water Development

HYDROLOGICAL AND ENVIRONMENTAL CONTROLS ON WATER MANAGEMENT IN AN ARID URBAN AREA,

Arizona Water Resources Research Center, Tuc-

For primary bibliographic entry see Field 04C. W71-06597

WATER AND RELATED LAND RESOURCES -STATE ADMINISTRATION, LEGISLATIVE PROCESS AND POLICIES IN MINNESOTA,

Minnesota Univ., Minneapolis. For primary bibliographic entry see Field 06E.

ENVIRONMENTAL LAW HANDBOOK, For primary bibliographic entry see Field 05G. W71-06600

CONSERVATION COMMISSIONS IN MAS-SACHUSETTS: WITH A SUPPLEMENTARY REPORT ON THE EMERGENCE OF CONSER-VATION COMMISSIONS IN SIX OTHER NORTHEAST STATES,

Conservation Foundation, Wash., D.C.; and New England Conservation Services Center, Lincoln,

For primary bibliographic entry see Field 06E. W71-06624

ENVIRONMENTAL IMPACT OF POWER PLANTS.

Corps of Engineers, Fort Belvoir, Va. Operations

For primary bibliographic entry see Field 05C. W71-06663

THE WATER WE LIVE BY-HOW TO MANAGE IT WISELY,

National Academy of Sciences, Washington, D.C. L. A. Heindl.

New York, NY, Coward-McCann Publishers, \$4.29, 1970, 127 p.

Descriptors: *Water resources development, *Water demand, *Water conservation, *Water pollution, *Water utilization, Surface waters, Groundwater, United States, Earth (Planet), Water quality, Water supply, Reviews.

Basic principals of the sound management of water are outlined, and specific examples of the difficul-ties which can result when these principles are ignored are cited. Also included are the relationship of water use and development, and the pollution of America's rivers and Great Lakes; the recent drought in New York State; the ecological problems of the Everglades; the dilemmas arising from irrigation of larger and larger areas of arid land; and the need to develop more hydroelectric power, while at the same time preserving large areas of wilderness for wildlife and recreation. (Woodard-USGS) W71-07038

07. RESOURCES DATA

7A. Network Design

SPECTRAL ANALYSIS - A PROTOTYPE STU-

Bureau of Reclamation, Denver, Colo.

H. T. Falvey, and D. L. King.
Paper presented at the American Society of Civil
Engineers Annual Hydraulics Division Conference, Logan, Utah, August 20-22, 1969. 9 p, 8 fig, 1 tab,

Descriptors: *Frequency analysis, *Turbulence, *Stilling basins, Vortices, Jets, Outlets, Hydraulic structures, Hydraulics, Instrumentation, Calibration, Piezometers.

Identifiers: *Spectral analysis.

Many critical areas should be considered when planning and performing spectral analyses of fluctuating signals. An important consideration in planning the analysis is determining how the results will be used. The analysis of data representing fluctuating water pressures in a prototype stilling basin was used to illustrate these considerations. Accuracy of the analyses should be consistent with design requirements. The equipment used was limited to the analysis of the frequency-amplitude spectrum at a single point on the structure. The capabilities and limitations of the commercially available instrument that was used in this study are discussed. Calibration procedures are described. The prototype stilling basin was designed to dissipate the energy of high-velocity flow from 2 hollow-jet valves. The basin was covered and the divider wall was supported at both top and bottom, providing the opportunity to measure the pressures without significant modification by flexure of the wall. (Knapp-USGS) W71-06511

EFFICIENCY OF HYDROLOGIC DATA COL-LECTION SYSTEMS, ROLE OF TYPE I AND II ERRORS

Arizona Univ., Tucson. Dept. of Systems Engineer-

Lucien Duckstein, and Chester C. Kisiel.

Research Report, Presented before Sixth American Water Resources Conference, Las Vegas, Nevada, October 1970. 23 p, 2 fig, 18 ref. OWRR Project B-007-ARIZ (6).

Descriptors: *Hydrologic data, *Mathematical models, *Statistical methods, *Risks, *Groundwater recharge, Costs, Efficiencies, Optimization, Decision making.
Identifiers: *Null hypothesis.

Data Acquisition—Group 7B

The purpose of this paper was to: review the overall problem of evaluating the efficiency of hydrologic data collection systems, present a mathematical basis for evaluating the relationship of risk Type 1 and Type II errors to one or more increments of data, and present examples. Identified were four aspects of error or risk: (a) choice of mathematical model for the same process, (b) accuracy and precision of parameter estimates, (c) acceptance of wrong hypothesis or rejection of correct hypothesis, and (d) economic losses associated with error. Of these four, the classical hypothesis testing problem was specifically evaluated in terms of costs associated with producer's (Type I) or consumer's (Type II) errors for simple and composite hypotheses. Mathematical models for these economic analyses included costs of sample data and costs of waiting while new data was obtained. An illustrative computational example focused on the hypothesis that natural recharge might be augmented by a system of pumping wells along an ephemeral channel. The relationship of the hypothesis testing problem to Bayesian decision theory was discussed; it was felt that the latter theory offered a more comprehensive framework for design and use of hydrologic data networks. (See also W71-06577 thru W71-06580) (Kriss-Cornell) W71-06576

EFFICIENCY OF PARAMETER AND STATE ESTIMATION METHODS IN RELATION TO MODELS OF LUMPED AND DISTRIBUTED HYDROLOGIC SYSTEMS,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

Chester C. Kisiel.
Research Report, January 1971. 26 p, 67 ref.
OWRR Project B-007-ARIZ (8).

Descriptors: *Hydrologic data, *Parametric hydrology, *Mathematical models, *Statistical methods, *Efficiencies, *Estimating, Risks, Distribution systems, Frequency analysis. Identifiers: *Lumped parameter models.

Four classes of errors, considered in problems of real-time control of hydrologic systems, were described as: (a) system representation, (b) parameter estimation, (c) truncation (in the approximation of model equations), and (d) roundoff (in the use of computers). Of prime concern was a review of the important philosophical and practical issues inherent in system representation and parametric estimation errors. Included in these two classes of error were (a) representation problem, and (b) identification problem. A detailed discussion of the identification problem and its relation to optimization theory and statistical estimation theory was given. System determinancy and in-determinancy was defined in terms of the number of variables, data points, and equations and elaborated in terms of design, identification and parameter estimation problems. Issues involved in choosing among models were: model validation, apparent and inherent randomness, and lumped and distributed parameter models interpreted by a frequency domain method. A heat flow problem was modeled by the latter methods and interpreted by autocorrelation and spectrum functions for the lumped model. A outline of Bayesian decision theory was presented and applied to evaluating the cost of uncertainty in the design of bridge piers. Uncertainty existed in the mean and variance of the log-normal distribution used to describe annual peak flows in Rillito Creek in Tucson, Arizona. (See also W71-06576) (Kriss-Cornell) W71-06577

ERROR ANALYSIS AND SYSTEM IDENTIFICATION OF WATER BALANCE AND THE RAINFALL EXCESS COMPONENT IN REAL AND MODEL WATERSHEDS,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

For primary bibliographic entry see Field 06A.

REMOTE 'EYES AND EARS' FOR FLOOD WARNINGS.

Corps of Engineers, Boston, Mass. New England

Frank P. Bane.

The Military Engineer, Vol 63, No 411, p 19-20, January-February, 1971. 2 p.

Descriptors: *Flood control, *Flood forecasting, *Remote sensing, *New England, *Coasts, Hurricanes, Sea water, Hydrologic data, Instrumentation, Methodology, Coastal structures, Wind tides, Computers, Meteorological data, Data transmission, Harbors, Network design, Saline water intrusion, Warning systems.
Identifiers: Flood warnings.

Protection of major port cities in New England which had been repeatedly wrecked by hurricane winds and ocean surges was provided by four barriers against hurricane-induced tidal flooding. To achieve the greatest operating benefits from this protection system, the Automatic Hydrologic Radio Reporting Network has been installed. Accurate and timely regulation of the dams and barriers require hydrologic data which include river, reservoir, and tidal levels; wind velocity and direction; barometric pressure; and precipitation. Many of the remote stations of the system are located in gaging stations operated by the Geological Survey for measuring stream flow. The Network consists of 41 remote reporting stations, 5 remote consists of 41 remote reporting stations, 3 remote recording stations, and a central control station at Division headquarters plus 12 repeater and 4 relay points. The operation of the control system is discussed. (Woodard-USGS) W71-06661

SPATIAL CORRELATIONS OF STORM, MONTHLY AND SEASONAL PRECIPITATION,

F. A. Huff, and W. L. Shipp.
J Appl Meteorol, Vol 8, No 4, p 542-550, Aug 1969. 7 diag, 6 tab, 1 graph, 7 ref.

*Measurement, *Precipitation. Descriptors: distribution, *Correlation analysis, *Rainfall intensity, *Illinois.

One approach to defining sampling requirements for precipitation measurement networks is through statistical correlation methods. Data from three dense rain gage networks in Illinois were used with this method on rainfall measurements ranging from 1-minute rates to total storm, monthly and seasonal amounts. Effects of rain type, synoptic storm type, and other factors on spatial correlations were studied. Correlation decay with distance used to indicate sampling requirements was greatest in thunderstorms, rain showers and air mass storms. Conversely, minimum decay occurred with steady rain and the passage of low pressure centers. Seasonally, the decay rate is much greater in May-September storms than in cold season precipitation. Sampling requirements are extreme in measuring rainfall rates; thus, assuming a minimum acceptance of 75% explained variance between sampling points, a gage spacing of 0.3 minutes is needed for 1-minute rain rates compared with 7.5 minutes for total storm rainfall in summer storms. W71-06968

7B. Data Acquisition

USE OF SIDE-LOOKING AIR-BORNE RADAR FOR SEA ICE IDENTIFICATION,

Coast Guard, Washington, D.C. Applied Sciences

Jimmie D. Johnson, and Dennis L. Farmer Journal of Geophysical Research, Vol 76, No 9, p 2138-2155, March 20, 1971. 18 p, 14 fig, 4 ref.

Descriptors: *Remote sensing, *Radar, *Ice, *Sea ice, Arctic, Icebergs, Navigation, Freezing, Ice jams, Warning systems. Identifiers: Side-looking radar.

An experiment was conducted to assess the performance of side-looking air-borne radar (SLAR) in mapping and identifying sea ice parameters. A Philco-Ford AN/DPD-2 (Modified) SLAR was installed on a Coast Guard C-130 aircraft and flown on an experimental basis during September 1969 in conjunction with the S.S. Manhattan's transit of the Northwest Passage. The SLAR was also used as a routing aid to the Manhattan. SLAR can readily be used to detect ice concentrations, floe size and number, and water openings, and to identify, through careful image interpretation, ice age, ice drift, surface topography, fractures, and pressure characteristics. SLAR's broad areal coverage, all weather day and night capability make it an effective means of observing sea ice, and for many purposes it provides observations superior to information obtained by a visual ice observer. SLAR imagery can be used in research efforts to study the formation, growth, and decay of sea ice and can be used operationally for ship routing and ice forecasting. (Knapp-USGS)
W71-06470

COMPARATIVE STUDY OF ELECTRICAL CONDUCTIVITY PROBES,

Iowa Univ., Iowa City. Iowa Inst. of Hydraulic

Research.
Carlos V. Alonso.
Text in English and French. Journal of Hydraulic
Research, Vol 9, No 1, p 1-10, 1971. 10 p, 5 fig, 1
tab, 8 ref. NSF Grant GK-2818; FWQA Grant WP-1218-01

Descriptors: *Tracers, *Electrolytes, *Electrical conductance, *Instrumentation, Calibrations, Flow, Density, Tracking techniques, Conductivity, Water chemistry.
Identifiers: Electrical conductivity probes.

The use of conductivity probes for measuring fluid movement through the corresponding changes in the electrical conductivity of a tracer substance (aqueous sodium chloride solution) is considered. A comparative description is given of the characteristics of several conductivity probes of different sizes and configurations. In order to compare the response of the different types of probes, they were tested under the same experimental conditions. In addition, tests were conducted to determine how much influence, if any, the orientation of the probes has on the conductivity measurements, and, finally, their response times were evaluated. (K-napp-USGS) W71-06477

MEASURING ILLUMINATION WITHIN SNOW COVER WITH CADMIUM SULFIDE PHOTO RESISTORS,

Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station. For primary bibliographic entry see Field 02C. W71-06495

THE UNIVERSITY OF ARIZONA'S GRAVITY

SURVEY PROGRAM, Arizona Univ., Tucson. Geophysics Lab. J. S. Summer, and R. E. West EOS (American Geophysical Union Trans) Vol 50, No 10, p 541-542, October 1969. 2 p, 3 fig, 5 ref. OWRR Project A-008-ARIZ (3).

Descriptors: *Gravity studies, *Surveys, Structural Descriptors: "Oravity studies, "Surveys, Structural geology, Aquifers, Alluvium, Alluvial channels, Land subsidence, Water levels, Water table, Recharge, Groundwater movement, Mapping, Maps, Arizona, Water resources research act. Identifiers: *Gravity surveys.

The Geophysics Laboratory at the University of Arizona has a continuing interest in making and analyzing gravity measurements over the Planning has started on compilation of an Arizona 1:500,000 scale gravity map to accompany the state geologic and magnetic maps. To date over 3000 gravity stations have been taken and com-

Field 07—RESOURCES DATA

Group 7B—Data Acquisition

piled by the University of Arizona. Interpretation of gravity data for the purpose of determining subsurface structural conditions continues to be an important practical and academic subject in this region. In the Basin and Range province to the west, surveys are useful in outlining pediment edges obscured by alluvial cover, and in determining the depth of sedimentary alluvial basins. It is important to know where pediment edges are for purposes of exploration for minerals and groundwater. Also, pediment edges form a zone of soil instability because basin sediments subside with groundwater withdrawal. Another use of gravity measurements that is being developed is the technique of resurveying points established near occasional streams, for the purpose of learning about variations in subsurface water levels. Gravity differences can be related to differences in the amount of subsurface water caused by seasonal changes or nearby pumped wells. (Knapp-USGS) W71-06504

METHODS AND APPLICATIONS OF ELECTRICAL SIMULATION IN GROUNDWATER STUDIES IN THE LOWER ARKANSAS AND VERDIGRIS RIVER VALLEYS, ARKANSAS AND OKLAHOMA,

Geological Survey, Washington, D.C. For primary bibliographic entry see Field 02F.

GRAVIMETRIC ICE THICKNESS DETERMINATION, SOUTH CASCADE GLACIER, WASHINGTON,

Geological Survey, Tacoma, Wash.
For primary bibliographic entry see Field 02C. W71-06508

DETERMINATION OF CARBONATE SATURATION OF SEAWATER WITH A CARBONATE

SATUROMETER,
California Univ., Los Angeles, Dept. of Geology;
and California Univ., Los Angeles. Inst. of
Geophysics and Planetary Physics.
S. Ben-Yaakov, and I. R. Kaplan.

Limnology and Oceanography, Vol 14, No 6, p 874-882, November 1969. 9 p, 5 fig, 3 tab, 19 ref. USAEC Contract AT (11-1)-34, Project No 178.

Descriptors: *Water chemistry, *Carbonates, *Chemical potential, *Sea water, *Saturation, Equilibrium, Hydrogen ion concentration, Instrumentation, Calibration, Laboratory tests, On-site tests, Calcium carbonate, Chemical precipitation. Identifiers: *Carbonate saturometers.

A mathematical model was established for the implementation of the Weyl saturometer, to obtain quantitative data on the degree of saturation of calcite and aragonite to within 2% when the chlorinity and pH of the measured seawater are known. The method also enables carbonate alkalinity to be estimated to within 10% of values obtained by titration. Nomograms are given for the determination of degree saturation and total CO2 for seawater of known pH, where a change in potential is measured after exposing a calibrated glass electrode to a slurry of calcium carbonate in the original seawater. (Knapp-USGS) W71-06513

THE DETECTION OF MAGNETIC FIELDS CAUSED BY GROUNDWATER AND THE COR-RELATION OF SUCH FIELDS WITH WATER DOWSING,

Utah Water Research Lab., Logan. Duane G. Chadwick, and Larry Jensen.

Available from NTIS as PB-198 343, \$3.00 in paper copy, \$0.95 in microfiche. Utah Water Research Laboratory Report PRWG 78-1, January 1971. 57 p, 27 fig. 8 tab, 9 ref, 2 append. OWRR Project B-033-UTAH (1). Matching Grant Agreement No. 14-31-0001-3133. Descriptors: *Dowsing, *Groundwater, *Magnetic studies, *Water sources, Water wells, Statistical methods, Equipment, Test procedures. Identifiers: *Water witching, *Dowsing techniques,

Dowsing tests.

Perturbations on the earth's magnetic field may coincide with groundwater bodies; various geologic formations have differing magnetic signatures. Some of the formations are water bearing; some are not. The magnetic field perturbations were plotted and numerous independent, individual dowsing tests were made at 4 principal locations. Objective was to see if water dowsers (1) obtain results which are independently corroborative and (2) obtain results which correlate in some way with magnetic field plots of the dowsed areas. About 150 people participated in the experiment over a one year period. Chi-square tests show considerable statistical significance. Nearly all the people involved in the project experienced dowsing reactions though most had never dowsed before. Some evidence exists of correlation between magnetic gradient changes and dowsing reactions. Concern is expressed that this report may be used to prove dowsing is an effective means of finding water if certain statements are taken out of context. It is emphasized that no wells were dug, tests by a few experienced dowsers did not have results better than novices, and only by statistics was it shown that some kind of undefined information might be present. (Lang-USGS) W71-06655

FIELD OBSERVATIONS ON THE USE OF SODIUM CYANIDE IN STREAM SURVEYS, Tennessee Game and Fish Commission. For primary bibliographic entry see Field 05C. W71-06724

THE NUCLEAR METHOD OF SOIL-MOISTURE

DETERMINATION AT DEPTH,
Texas Univ., Austin. Center for Highway Research.
For primary bibliographic entry see Field 02G.
W71-06779

A NUMERICAL INVESTIGATION OF TIDAL CURRENT CIRCULATION IN THE GULF OF MAINE.

Naval Postgraduate School, Monterey, Calif. For primary bibliographic entry see Field 02L. W71-06801

A NEW TECHNIQUE FOR SOIL STRAIN MEA-SUREMENT,
For primary bibliographic entry see Field 08D.

W71-06841

RAPID MEASUREMENT OF DRAINAGE DEN-

Kentucky Univ., Lexington. Dept. of Geography. For primary bibliographic entry see Field 04A. W71-07010

THE POSSIBILITY OF METEOROLOGICAL SATELLITE OBSERVA-TIONS FOR THE STUDY OF ANTARCTIC ICE, P. Glade, H. Gernandt, and V. A. Shamont'yev. Translated from Informatsionnyi Byulleten' Sovet-skoi Antarticheskoi Ekspeditsii, No 73, p 27, 1969. Soviet Antarctic Expedition Information Bulletin, Vol 7, No 4, p 296-299, February 1971. 4 p, 3 fig, 3

Descriptors: *Aerial photography, *Antarctic, *Satellites (Artificial), Remote sensing, Ice, Glaciers, Coasts, Icebergs, Surveys, Mapping. Identifiers: *Antarctic ice.

Meteorological satellite observations can aid in the study of antarctic ice. The photographs taken by the satellite from an altitude of about 1000 km depict areas of the earth's surface measuring approximately 2500 x 2500 km, and the scale of the photographs is close to 1:15,000,000. The satellite photographs clearly show the configuration of the coastline. Meteorological satellite observations show great promise for the study of antarctic ice. The information received from satellites is an additional statement of the configuration of the coastline. tional source of data concerning the variations in the general position of the antarctic ice shore, needed for the study of the mass balance of the Anneeded for the study of the mass balance of the Ali-tarctic ice sheet. The recording of large icebergs on photographs over a long period of time will help refine their drift trajectories in antarctic waters. These data can be used for the observation of large accumulations of fast and drift ice off the coast of Antarctica. (Knapp-USGS) W71-07023

A STUDY OF THE WATER BALANCE OF A NATURAL CATCHMENT USING A NEUTRON-SCATTERING MOISTURE METER, Road Research Lab., Crowthorne (England). For primary bibliographic entry see Field 02D. W71-07042

GAMMA-RADIATION DETECTION OF WATER CONTENT IN TWO-DIMENSIONAL EVAPORATION PREVENTION EXPERIMENTS, Iowa State Univ., Ames. Dept. of Agronomy. For primary bibliographic entry see Field 02D. W71-07044

7C. Evaluation, Processing and Publication

AN AUTOMATIC RECORDING FIELD STATION FOR COLLECTING ENVIRONMENTAL DATA,

Geological Survey, Arlington, Va.

Wallace M. Yater, Jr.
BioScience, Vol 21, No 1, p 11-15, January 1, 1971. 5 p, 5 fig, 3 ref.

Descriptors: *Data collections, *Hydrology, *Remote sensing, *Automation, *Data transmission, Soil moisture, Rainfall, Temperature, Instrumentation, Electrical resistance, Methodology, Data processing, Data storage and retrieval, Computers, Equations, Computer programs. Identifiers: Digital tape, Magnetic tape.

An automated system for recording soil moisture, rainfall, temperature, and microchanges in tree radius in several different type habitats is described. The data are punched on paper tape which can be transcribed to magnetic tape for computer use. All of the sensors were designed so that their electrical resistance would vary over all or part of a 0 to 41,000 ohm range. This matching of the resistance ranges of the sensors to the measur-ing circuit permits the same Wheatstone bridge circuit to measure all of the sensors. The same servo motor that balances the bridge simultaneously positions to digit cams of a Fischer and Porter digital recorder, which punches a four-digit binary decimal number in 16-channel paper tape at the end of the balancing cycle. A 6-volt battery drives the bridge balancing, primary step switch, and digital punch mechanism motors, while a 12-volt battery powers the transistor amplifier and the bridge and actuates the solenoids in the Ledex secondary step switches. The system cost about \$4800 in 1968. This includes the bridge servo, digital recorder, sensors (excepting dendrometers for the tree radius measurement), and payment to a private contractor to design and construct the bridge, switching system, instrument and battery shelters, and junction boxes. (Woodard-USGS) W71-06467

ON THE SOLUTION OF TRANSIENT FREE-SURFACE FLOW PROBLEMS IN POROUS MEDIA BY FINITE-DIFFERENCE METHODS, Oslo Univ. (Norway). Inst. of Geophysics.

For primary bibliographic entry see Field 02F W71-06471

FINITE DIFFERENCE SOLUTION OF THE FLOOD DIFFUSION EQUATION,
Birmingham Univ. (England). Graduate School of Water Resources Technology; Birmingham Univ. (England). Dept. of Civil Engineering; and Essex River Authority (England).
For primary bibliographic entry see Field 02E.
W71-06472

GROUNDWATER FLOW IN HETEROGENE-OUS, ANISOTROPIC FRACTURED MEDIA: A SIMPLE TWO-DIMENSIONAL ELECTRIC ANALOG

Centre d'Hydrogeologie, Neuchatel, Switzerland. Geological Institute.

For primary bibliographic entry see Field 02F. W71-06475

QUANTITATIVE SLOPE ASPECT DETER-

MINATION,
Agricultural Research Service, Beltsville, Md. Hydrograph Lab. C. B. England.

Journal of Hydrology, Vol 12, No 3, p 262-268, February 1971. 7 p, 5 fig, 1 tab, 3 ref.

Descriptors: *Terrain analysis, *Mapping, *Slopes, *Topography, Small watersheds, Profiles, Surveys, Evapotranspiration, Maps, Geomorphology. Identifiers: *Slope determination.

A rapid and efficient method is described for quantifying slope exposure using only a T-square and tri-angle on a topographic map. Results of aspect determination using this technique on a small Wisconsin watershed are compared with those obtained by point sampling. Since the proposed method accurately defines the boundaries between aspect units, and requires less than one-third the time, it has distinct advantages over point sampling, which can erroneously define the boundaries. Proposed use of this method is to derive aspect parameters for a watershed evapotranspiration model. (Knapp-USGS) W71-06476

APPLICATIONS OF INFORMATION AND GRAPH THEORY TO MULTIVARIATE GEOMORPHOLOGICAL ANALYSES,

Colorado Univ., Boulder. Inst. of Arctic and Alpine Research; and Colorado Univ., Boulder. Dept. of Geological Science.

J. T. Andrews, and G. Estabrook

Journal of Geology, Vol 79, No 2, p 207-221, March 1971. 15 p, 4 fig, 10 tab, 19 ref. NIH Grant GM 13974; ONR Contract Nonr 3640 (00).

Descriptors: *Statistical methods, *Geomorphology, Correlation analysis, Stochastic processes, Surveys, Digital computers, Particle shape, Topography, Glacial drift, Probability.

*Graph theory, *Baffin Island Identifiers: (Canada).

Some methods of examining the interrelationships among variables (R-mode) and among individual objects (Q-mode) require measurements on an interval or ratio scale, and are frequently not useful in many geomorphological studies where lower many geomorphological studies where lower measuring scales are employed. By contrast, the information- and graph-theory methods use nominal scale data. Their use is illustrated by a discussion based on a 41 (objects) X 12 (variables) matrix relating to the cross-valley moraines of Baffin Island. The variables measure moraine shape, location till fabrics and clast roundness. The information till fabrics and clast roundness. tion, till fabrics, and clast roundness. The information-theoretic approach generates a measure of distance and computes the amount of shared infor-mation between the variables. Unconditional and conditional probability tables are used to assess the stochastic dependence among states of two variables. Graph-theoretic methods are used to develop a measure of similarity that is then used in a classification of the moraines. The characters that share most information are two measures of clast roundness and the dip pattern of till fabric. Two classifications are developed that share considerable in-

formation with moraine shape and location within the valley; 'hooked' and 'asymmetric' moraines were found to be quite different from each other. Since the techniques use nominal data, they should have general applicability in several fields of geology. (Knapp-USGS) W71-06486

WATER RESOURCES OF SPARTANBURG COUNTY, SOUTH CAROLINA, Geological Survey, Columbia, S.C.

For primary bibliographic entry see Field 02E.

SUMMARY OF DATA ON CHEMICAL QUALITY OF STREAMS OF NORTH CAROLINA, 1943-1967, Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 02K. W71-06489

EXPERIMENTAL PROGRAM FOR ANALYSIS AND VALIDATION OF WATERSHED MODELS, Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

For primary bibliographic entry see Field 06A. W71-06580

LEAST COST SAND FILTER DESIGN FOR

IRON REMOVAL, lowa State Univ., Ames. Dept. of Civil Engineering; and Iowa State Univ., Ames. Engineering Research

For primary bibliographic entry see Field 05D.

HEC-3 RESERVOIR SYSTEM ANALYSIS. Corps of Engineers, Davis, California. Hydrologic Engineering Center.

For primary bibliographic entry see Field 04A. W71-06586

ANNUAL PEAK DISCHARGES FROM SMALL DRAINAGE AREAS IN MONTANA THROUGH SEPTEMBER 1970,

Geological Survey, Helena, Mont.
For primary bibliographic entry see Field 02E. W71-06667

DRAINAGE AREA STATISTICS FOR THE CHESAPEAKE BAY FRESH-WATER CHESAPEAKE BAY FRESH-WATER DRAINAGE BASIN,
Johns Hopkins Univ., Baltimore, Md., Chesapeake

For primary bibliographic entry see Field 02E. W71-06668

RECONNAISSANCE OF SELECTED MINOR ELEMENTS IN SURFACE WATERS OF THE UNITED STATES, OCTOBER 1970, Geological Survey, Washington, D.C. W. H. Durum, J. D. Hem, and S. G. Heidel. Free on application to the US Geological Survey, Weshington, D.C. 2022, Geological Survey, Circus Washington, DC 20242. Geological Survey Circular 643, 1971. 49 p, 6 fig, 1 tab, 3 ref.

Descriptors: *Trace elements, *Water analysis, *United States, *Puerto Rico, *Water chemistry, Sampling, Rivers, Lakes, Laboratory tests, Chemical analysis, Cobalt, Chromium, Data collections, Surface waters, Water supply, Natural streams, Industrial wastes, Municipal wastes.

Identifiers: *Mercury, Arsenic, Cadmium, Lead,

A nationwide reconnaissance of selected minor elements in water resources of the 50 States and Puerto Rico was made by the U.S. Geological Survey in cooperation with the U.S. Bureau of Sport Fisheries and Wildlife during autumn, 1970. The more than 720 samples collected from rivers and lakes were analyzed for arsenic, cadmium, chromium (hexavalent), cobalt, lead, mercury, and zinc. A summary of the results for each element is given and analytical results are tabulated. Data on mercury are reported in two forms: dissolved and total. The concentration of the dissolved form is an indication of what might occur in a treated or filtered water supply at the same sampling point. Total mercury represents the amount in the water-sediment mixture. In none of the dissolved mercury samples did the concentration exceed the proposed Public Health Service upper limit for dissolved mercury in drinking water, which is 5 millionths gram per liter. Total mercury was found in excess of this concentration in a few instances. (Woodard-USGS) W71-06670

SURFACE WATER SUPPLY OF THE UNITED STATES, 1961-65: PART 2. SOUTH ATLANTIC SLOPE AND EASTERN GULF OF MEXICO BASINS.

Geological Survey, Washington, D.C.

Crest stage.

For sale by the Superintendent of Documents, US Government Printing Office, Washington, DC, 20402, as 119.13:1904, Price \$4.25. Geological Survey Water-Supply Paper 1904, 1970. 942 p, 1 fig, 1 plate.

Descriptors: *Surface waters, *Streamflow, *Flow measurement, *Stream gages, *Gaging stations, Data collections, Flow rates, Average flow, Low flow, Peak discharge, Lakes, Reservoir stages. Identifiers: *South Atlantic slope, *Eastern Gulf of Mexico basins, Stream discharge, Flow extremes,

This volume is one of a series of 37 reports presenting records of stage, discharge, and content of streams, lakes, and reservoirs in the United States streams, takes, and reservoirs in the United States during the 1961-65 water years. The data reported comprise a description of the gaging station, and tables showing the daily, monthly, and yearly discharges of the stream. The description of the station gives the location, drainage area, records available, type and history of gages, average discharge, extremes of discharge, and general remarks. For most gaging stations on lakes and reservoirs the data presented comprise a description of voirs the data presented comprise a description of the station and a monthly summary table of stage and contents. Data for partial-record stations are presented in two tables. The first is a table of discharge measurements at low-flow partial-record stations, and the second is a table of annual maximum stage and discharge at crest-stage stations. (Woodard-USGS) (Woodard-W71-06674

THE KANSAS CITY DISTRICT SUSPENDED SEDIMENT LOAD COMPUTER PROGRAM, Corps of Engineers, Kansas City, Mo. For primary bibliographic entry see Field 02J. W71-06685

CURRENT DUTCH PRACTICE FOR EVALUATING RIVER SEDIMENT TRANSPORT PROCESSES,

Corps of Engineers, St. Paul, Minn. Reservoir and Hydrologic Engineering Section. For primary bibliographic entry see Field 02J. W71-06686

WATER TEMPERATURES OF CALIFORNIA STREAMS, NORTH COASTAL SUBREGION,

Geological Survey, Menlo Park, Calif.

Geological Survey Open-file Report, July 6, 1970. 92 p, 4 fig, 1 tab, 24 ref.

Descriptors: *Water temperature, *Streams, *Data collections, *Hydrologic data, *California, Fluctuation, Average flow, Gaging stations, Thermometers, On-site data collections, Frequency.

Identifiers: *Northwestern California, Thermograph stations, Daily measurements.

Group 7C-Evaluation, Processing and Publication

A summary of water-temperature records is presented for data collected through September 1968 in the North Coastal Subregion of California. This report is one of a series covering the 11 hydrologic subregions of the State and includes data for 120 stream sites. Water temperatures, in data for 120 stream sites. Water temperatures, in degrees Celsius, are summarized by months, years, and for the period of record. A description is included to identify each station where data were collected. A tolerance interval analysis indicates that 99 percent of the point water-temperature observations, determined either with thermograph probes or hand-held thermometers, should be within 1.1 deg F of the mean water temperature at the 95-percent confidence level. The summary data for each site may be used to provide guidelines for the establishment of thermal standards used in water-quality management. (Woodard-USGS) W71-06699

FINITE ELEMENT SOLUTION OF STEADY STATE POTENTIAL FLOW PROBLEMS.-THE HYDROLOGIC ENGINEERING CENTER GENERALIZED COMPUTER PROGRAM 723-

Corps of Engineers, Davis, Calif. Hydrologic Engineering Center.

Army Corps of Engineers Hydrologic Engineering Center Report, November 1970. 48 p, 22 fig, 3 tab, 22 ref, 5 append.

Descriptors: *Model studies, *Groundwater move-ment, *Steady flow, *Potential flow, *Computer programs, Porous media, Mathematical models, programs, Porous media, Mathematical models, Equations, Data storage and retrieval, Programming languages, Darcys law, Hydrogeology, Hydraulic, Hydraulic conductivity, Flow characteristics, Boundaries (Surfaces), Pressure, Dynamics, Velocity, Hydraulic gradient.

This computer program is intended for application to problems involving steady, two-dimensional or axisymmetric flow through heterogeneous, anisotropic porous media of virtually any internal or external geometry. Although the program was developed primarily with groundwater and seepage problems in mind, it is equally applicable to potential flow problems of any type, such as those involv-ing heat conduction or electric potential distribu-tion. The basic equations that are solved numerically by the finite element method are derived on the basis of a number of assumptions as to the physics of motion and achievement of continuity of mass. These equations include the differential form of Darcy's Law, the continuity equation, and derived basic flow equations. This program uses the finite element numerical method to solve second order, linear partial differential equations, and associated boundary conditions. The program as dimensioned can handle up to 400 nodes, 400 elements, 20 conductivity zones, 100 specified nodal values of potential, 200 sources or sinks and 100 values of potential, 200 sources or sinks and 100 values of potential, 200 sources or sinks and 100 values of potential, 200 sources or sinks and 100 values of potential, 200 sources or sinks and 100 values of potential, 200 sources or sinks and 100 values of potential, 200 sources or sinks and 100 values of potential va wants of potential, 200 sources of sinks and 100 known-flow boundaries. It occupies about 31,000 words of core on a CDC 6600 computer. Each input card is described in detail, and a summary of input cards is included. (Woodard-USGS) W71-06701

HYDROLOGY ANNUAL NO 14 - 1966.

Soil Conxerv and Rivers Control Council Annual Hydrol Rep, 1968. 247 p, 5 fig, 19 ref.

Descriptors: *Data collections, *Hydrologic data, *Bibliographies, Streamflow, Stream gages, Snow surveys, Snow cover, Low flow, Floods, Discharge (Water), Recession curves, Sediment load, Suspended load, Water quality, Channel morphology, State-discharge relations. Identifiers: *New Zealand.

Hydrologic data collected at 25 stations in New Zealand in 1966 are tabulated. Collected data include a list of streamflow stations, precipitation gages, sediment gages, water quality stations, snow courses, groundwater observation sites, representa-tive and experimental basins, streamflow tables, snow survey data, recession curves, suspended sediment rating curves, water quality data, flood data, and channel morphology and efficiency surveys. An annotated bibliography of hydrological papers about New Zealand and by New Zealand ical and meteorological authorities and agencies collecting data are also included.
W71-06962 authors is included. Addresses of all local hydrolog-

RAIN-GAUGING PROGRAM TO PROVIDE GUIDE TO STORM SEWER DESIGN, For primary bibliographic entry see Field 08B. W71-06964

A SHORTCUT FOR COMPUTING STREAM DEPLETION BY WELLS USING ANALOG OR DIGITAL MODELS,

Geological Survey, Denver, Colo. O. James Taylor. Groundwater, Vol 9, No 2, p 9-11, March-April 1971. 3 p, 2 fig, 2 tab, 4 ref.

Descriptors: *Surface-groundwater relationships, *Mathematical models, *Computer programs, *Analog models, Simulation analysis, Withdrawal, Drawdown, Recharge, Aquifers, Hydrogeology, Aquicludes, Alluvial channels. Identifiers: Alluvial aquifers.

Theory indicates that the effect of a discharging well on streamflow in a stream-aquifer system is in-dependent of the length of the reach. The theory was verified using a digital computer model of short and long reaches of a stream-aquifer system. The theory was extended successfully to a heterogeneous stream-aquifer system having sinuous boundaries where the stream was reasonably straight. Within tested limits, a model of a short reach will give results comparable in accuracy to one of a long reach with considerably less effort and expense. (Knapp-USGS) W71-07006

IN

GROUNDWATER FLUCTUATIONS RESPONSE TO ARBITRARY PUMPAGE, Illinois State Water Survey, Urbana. For primary bibliographic entry see Field 02F. W71-07007

COMPUTER ORIENTED STABILITY ANALY-

SIS OF RESERVOIR SLOPES, Purdue Univ., Lafayette, Ind. School of Civil En-For primary bibliographic entry see Field 08D. W71-07058

08. ENGINEERING WORKS

8A. Structures

DROP INLET REPAIRS STORMS DAMAGE TO SEWER SYSTEM.

For primary bibliographic entry see Field 05G. W71-06544

RX FOR

For primary bibliographic entry see Field 05G. W71-06550

URBAN RENEWAL IN WHITE PLAINS, NEW YORK,

J. Michael Divney. Civil Eng, Vol 39, No 9, p 69-72, Sept 1969.

Descriptors: *Urban renewal, Storm drains, New Identifiers: *White Plains (NY).

In an urban renewal program in White Plains, N. Y., a scatter housing plan was developed. A scheme employing pairs of one-way streets and at-grade in-tersections was used. The Davis Brook storm drain (84 in. diameter, 3000 ft. long) will divert the route of the David Brook culvert from the center of the project to the Bronx River, along the southern boundary of the project. The pipes were jacked under the commuter rail line, and gravel was pumped into the voids, thus stopping the track settlement. W71-06556

HANDBOOK OF STEEL DRAINAGE AND HIGHWAY CONSTRUCTION PRODUCTS.

Am Iron Steel Inst, New York, NY, 1967. 382 p.

Descriptors: *Drainage, *Construction, *Design data, *Design, *Steel, *Steel structures, *Installation, *Application methods, Construction materials. Construction equipment.

The main purpose of this handbook is to aid engineers in overcoming problems involved in highway, railway, municipal, agricultural, and industrial drainage and construction. The text aims to present engineering practices based on sixty years of practical experience compatible with existing technology. Design data and designed aids are cited extensively, while theory is kept at a minimum. The design and application of flexible steel underground conduits, plus good installation practices, are described in the first two parts of the book. The third part concerns other steel products for related construction. The first part on general design considerations includes chapters on: product details, strength design, service life, hydraulics, cost factors, couplings and fittings, and installation instructions. Part II on applications covers the following subjects: culverts, sewers, subdrainage, airport drainage, erosion prevention, dam and levee drainage, tunnels, shafts, caissons, underpasses, and service tunnels. The book also contains a glossary of terms, a list of symbols, conversion tables, general tables, and gage/height-of-cover tables. (See also W71-06640 thru W71-06648) W71-06639

HANDBOOK OF STEEL DRAINAGE AND HIGHWAY CONSTRUCTION: CHAPTER 1 - PRODUCT DETAILS.

Am Iron Steel Inst, New York, NY, p 10-37, 1967. 14 fig, 22 tab, 14 ref.

Descriptors: *Underground structures, *Conduits, *Steel, *Analysis, Steel structures, Design, Surface drainage, Subsurface drainage, Bypasses. Identifiers: Storm sewers.

This chapter studies product details involved in design of flexible steel underground conduits. Design factors are listed, and the book elects to begin with an analysis of the required strength factor of the conduit wall. The background of corrugated steel conduits is given as well as specifications in common use; a description of corrugations, sectional properties, pipe seams, and shapes of conduits; data on structural plates that are field assembled, and on bolts and nuts, and arch channels. The following three principal types of undergound conduits are introduced: (1) conduits for surface drainage, such as culverts, storm sewers, and stream enclosures; (2) conduits for subdrainage for controlling underground water; and (3) conduits for traffic underpasses, and service passes. (See also W71-06639) W71-06640

HANDBOOK OF STEEL DRAINAGE AND HIGHWAY CONSTRUCTION: CHAPTER 2 -STRENGTH DESIGN.

American Iron and Steel Inst., New York.

Am Iron Steel Inst, New York, NY, p 38-63, 1967. 18 fig, 5 tab.

A theoretical assessment of dynamic response of

Structures—Group 8A

Descriptors: *Design, *Underground structures, *Design criteria, *Strength of materials, Design data, Operation and maintenance.

Design methods discussed in this chapter are based on more than sixty years satisfactory field experience with buried flexible structures. The new design approach explained considers overall needs of the drainage structure--environment, service demands, and strength requirements under dead and live loads. Computer analysis is practical and is an anticipated future development when sufficient research evaluates the influence of different soils and compactions on the structure. The following topics are treated in the chapter in the same sequence in which decisions are made in designing buried structures: (1) computation of loads; (2) culvert structural design; (3) earth backfill design; (4) foundation preparation; (5) minimum cover; (6) end treatment; and (7) maintenance. (See also W71-06639) W71-06641

HANDBOOK OF STEEL DRAINAGE AND HIGHWAY CONSTRUCTION CHAPTER 3 - SERVICE LIFE. PRODUCTS:

American Iron and Steel Inst., New York For primary bibliographic entry see Field 08F. W71-06642

HANDBOOK OF STEEL DRAINAGE AND HIGHWAY CONSTRUCTION CHAPTER 4 - HYDRAULICS. PRODUCTS:

For primary bibliographic entry see Field 08B.

HANDBOOK OF STEEL DRAINAGE CONSTRUCTION PRODUCTS: CHAPTER 15 - COST FACTOR.

Am Iron Steel Inst, New York, NY, p 142-150, 1967. 5 fig, 4 tab, 4 ref.

Descriptors: *Maintenance costs, *Cost analysis, *Cost trends, *Cost comparisons, Costs, Economic

Cost per year of service depends on durability, maintenance, ease of replacement, and factors influenced by local conditions. Recent trends show an increase in pre-engineered and prefabricated structures with consequent reduction of on-the-job labor. This has the following three-way effect: (1) promotes factory-controlled quality under more ideal working conditions; (2) by reducing design and inspection time, it permits the engineer to concentrate on the whole job rather than its details; and (3) although product cost may be higher, installed cost is usually less. Subsections of this chapter discuss: (1) price vs. cost; (2) cost items included; (3) material cost; (4) hauling and handling; (5) excavation and backfill; (6) installation; (7) replacing the traffic surface; (8) detours, slow orders; (9) supervision, overhead contingencies insurance; (10) engineering costs; (11) unstable foundation conditions; and (12) the cost end of treatment. (See also W71-06639) W71-06644

HANDBOOK OF STEEL DRAINAGE AND HIGHWAY CONSTRUCTION PRODUCTS: CHAPTER 6 - COUPLINGS AND FITTINGS. Am Iron Steel Inst, New York, NY, p 151-159, 1967. 16 fig.

Descriptors: *Steel pipes, Joints (Connections), Installation, Design data. Identifiers: *Couplings.

Shop-fabricated corrugated steel pipe and pipearches are delivered in lengths convenient for shipping and handling. For longer installed lengths, standard connecting bands or special field joints are used. Joint selection criteria covered in this chapter include strength, joint tightness, simplicity, and economy of installation. Also treated are design features of couplings, standard and special fittings, fabrication details, and field installation of fittings. (See also W71-06639) W71-06645

HANDBOOK OF STEEL DRAINAGE AND HIGHWAY CONSTRUCTION PRODUCTS: CHAPTER 9 - SEWERS.

Am Iron Steel Inst, New York, NY, p 202-211, 1967. 9 fig, 4 ref.

Descriptors: *Sewers, *Design standards, *Treatment facilities, Sewerage, Steel, Equipment, Control systems, Control structures.

Identifiers: *Sewer design, Steel structures, Storm sewers, Combined sewers, Sanitary sewers.

This chapter defines terminology associated with sewers and sewerage and explains basics involved in the following areas: sewer system design, corrugated steel sewers, storm sewer inlets, standard and special fittings, manholes, sewers joints and outfalls, sewage treatment plants and lagoons, septic tanks, water control gates, and sewer maintenance and repair. Definitions include: sewer, sewage, storm sewer, sanitary sewer, combined sewer, industrial wastes, half-soling, threading, and tunneling. (See also W71-06639)
W71-06647

HANDBOOK OF STEEL DRAINAGE AND HIGHWAY CONSTRUCTION PRODUCTS: CHAPTER 11 - AIRPORT DRAINAGE.

Am Iron Steel Inst, New York, NY, p 240-247, 1967. 4 fig, 2 tab, 4 ref.

Descriptors: *Surface runoff, *Drainage systems, *Controlled drainage, *Design standards, *Standards, *Drainage practices, *Rainfall-runoff rela-

Identifiers: *Airport drainage.

The purpose of airport drainage is to remove water which may hinder any activity necessary for the safe and efficient operation of the airport. Artificial facilities are needed to collect surface runoff, dispose of excess groundwater, lower the water table, and protect slopes. Characteristics of airport drainage are summarized, and a list is presented of information needed prior to designing the drainage system. Requirements of airport drainage differ from those of culverts, storm drains, and subdrainage of highways, railways, industrial areas, agricultural, urban, and suburban areas; and these differences are reviewed, especially in regard to rainfall-runoff computations. Four types of drainage appearing on airports are mentioned, and Federal Aviation Agency recommended standards are listed. Remaining sections of the chapter concern the size of conduits, the selection structures, and storm drains. (See also W71-06639) W71-06648

EARTHQUAKE RESPONSE OF ARCH DAMS, Assam Engineering Coll., Gauhati (India); and Southampton Univ. (England).
U. C. Tahbilder, and H. Tottenham.

Proceedings American Society of Civil Engineers, Journal of the Structure Division, Vol 96, No ST11, p 2321-2336, Nov 1970. 16 p, 13 fig, 23 ref, 2 append.

Descriptors: Damping, Dams, Dam design, *Arch dams, *Dynamic response, Concrete dams, Deformation, *Earthquakes, *Finite element method, Stress analysis, Dynamic loads, Earthquake loads, Structural behavior, Computer applications, Stress, Analytical techniques, Acceleration (Physics), Seismic design, Displacements, Bibliographies, Foreign research. Identifiers: Great Britain.

arch dams caused by earthquakes is attempted using the finite element shell formulation. Results of the analysis reveal that seismic forces can induce high tensile stresses in arch dams, and should be given serious consideration in seismic-resistant design. The dam is idealized as an assemblage of rectangular elements with consistent mass distribution and viscous damping. The reservoir is taken into account by considering the added mass. Response to ground accelerations is evaluated by step-by-step integration of governing differential equations assuming a certain variation of dam acceleration within a short time interval. The method is stable and provides greater economy in computing time than the normal mode method. Response for a particular dam is obtained for 3 earthquakes: El Centro, May 18, 1940; Santa Barbara, June 30, 1941; and Taft, July 21, 1952. (USBR) W71-06843

LOWESTOFT CHOOSES TUNNEL FOR SEWAGE OUTFALL.

Surveyor, Vol 84, No 4030, p 18, Aug 29, 1969. 2

Descriptors: *Outlets, *Sewerage, *Construction, *Currents (Water), *Cost, *Tunnel design, Descriptor, Construction, Tunnel construction, Tunneling machines, Waste disposal.

The sewage outfall project at Lowestoft is controversial in concept as well as in mode of construction. Problems of such outfalls include their frequent damage by heavy seas and their questionable ability to adequately disperse effluents. Sea currents at discharge points were investigated and found to be conducive to properly carrying effluent out to sea. The slightest beach pollution, however, will promote intense public distrust of the plan. Discharge shafts of the tunnel beneath the sea-bed will be raised through the use of massive hydraulic jacks, and unusual technique. Both the tunnel work and the shaft raising will be done employing com-pressed air. Dimensions of the tunnel and other construction techniques and problems are related. The scheme adopted is inexpensive with regard to capital and service costs. A complete sewage treatment works for the town would cost at least twice as much. W71-06854

WATER SUPPLY AND WASTE DISPOSAL, For primary bibliographic entry see Field 05G. W71-06879

PIPING FOR WATER AND SEWER SYSTEMS, For primary bibliographic entry see Field 05G.

COLLECTION AND TRANSPORTATION OF SEWAGE,

For primary bibliographic entry see Field 05G. W71-06884

WATER WELL HANDBOOK, Missouri Water Well and Pump Contractors Association, Rolla, Mo.

Keith E. Anderson.

St. Louis, Scholin Brothers Printing Corp, Second Edition, 1967. 281 p.

Descriptors: *Water wells, *Drilling, Rotary, Water quality, Casing, Well hydraulics, Drilling equipment.

Identifiers: *Cable tool drilling, Pumps, Flow measurement, Mathematical formuli and conversion tables. Electrical data.

Drillers, engineers, and geologists working with water wells have occasion to refer frequently to charts, tables and other data which are scattered throughout many books and catalogs. At present,

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there has been no convenient reference source available which brings much of this information available which brings much of this information together. This booklet has been prepared for that purpose. An attempt has been made to bring together only the information most frequently referenced to by persons working with groundwater supplies. It is well indexed to assure usability. (Campbell-NWWA) W71-06919

CABLE TOOL FISHING, Water Well Journal Publishing Co., Urbana, Ill. M. G. Decker.

Urbana, Water Well Journal Publishing Co, 1968.

Descriptors: *Drilling, *Water wells, Drilling equipment, Oil industry, Groundwater.

Identifiers: *Cable-tool drilling, Fishing string, Sockets, Casing problems, Latch jacks, Whip

Drilling cables and sand lines should be watched carefully for signs of weakness or unusual wear; drilling tools should be inspected for fatigue cracks, particularly at welds; tool joints should be returned at regular periods; and no equipment or tools should be lowered into the well unless, as far as can be detected, they are in perfect condition. Fishing is the cause of annoying delays and financial loss in drilling operations. Therefore, it is essential to take every precaution with drilling tools, and to exercise every precaution with drilling tools, and to exercise care in drilling, in order to avoid as many fishing jobs as possible. However, in anticipation of the in-evitable fishing job, it is a good plan to record the exact dimensions of everything used about, or in, the well so that information will be at hand for designing or selecting a suitable fishing tool. Any work being done in the drilling, cleaning out, or servicing of a gas, oil, or water well involves the risk of (1) failure of the drilling tools or the casing, or result in a fishing job. Thus the hazards of fishing are frequently the cause of high drilling costs. (Campbell-NWWA) W71-06921 (2) erroneous procedure - either of which may

GROUNDWATER PRODUCTION FROM THE BEDROCK OF SWEDEN, Craelius Terratest AB, Stockholm (Sweden).

Geological Dept. Martin G. Beyer.

Proceedings of the International Symposium, Stockholm, October 1966, Published by Pergamon Press, Chapter 10, p 161-179, 1968.

Descriptors: *Drilling, *Water wells, Groundwater, *Sweden, Igneous rock, Metamorphic rock. Identifiers: *Air drilling, *Cable tool drilling, Precambrian aquifers, Seismic profiles, Municipal water supply, Well locations.

The ever-increasing fresh water quantities needed for the supply of growing communities recreation areas and industries in Sweden has greatly in-creased the amount of water drawn from the mainly Precambrian bedrock. Drilling methods by compressed air now being introduced are many times more efficient than conventional cable tool drilling. Increased output and closer spacing of wells, however, demand closer over-all control of bedrock groundwater resources. (Campbell-NWWA) W71-06923

WAVE ABSORBERS IN HARBORS,

National Engineering Science Co., Pasadena, Calif. Bernard Le Mehaute

Available from NTIS as AD-704 721, \$3.00 in paper copy, \$0.95 in microfiche. Waterways Experiment Station Contract Report CR 2-122, June 1965. 124 p. Contract DA-22-079-CIVENG-64-

Descriptors: *Waves, *Energy transfer, *Harbors, *Breakwaters, Absorption, Mathematical models, Beach erosion, Seiches.

Identifiers: *Wave absorbers.

It is the purpose of this report to analyze the effect of wave absorbers on harbor agitation. A critical analysis of the previous studies on wave absorbers is presented. Then an attempt is made to improve the state of the art in the design of wave absorbers and in particular of rubble mound wave absorbers. A study on scale effects of wave absorbers built in scale models for studying wave agitation in harbors is also presented. Aside of the literature survey and general considerations on wave absorbers, a number of new theories have been developed and presented within this report. W71-06930

MODERN WATER WELL DRILLING TECHNIQUES IN USE IN THE UNITED KING-DOM,

Stow and Co., Ltd., Henley (England). G. R. S. Stow.

Groundwater, Vol 1, No 3, p 3-12, July 1963.

Descriptors: *Water wells, *Drilling, *England, Rotary drilling, Well development, Screens, Acids. Identifiers: *Cable tool drilling, Chilled shot core drilling, Mud flush rotary drilling, Reverse circulation rotary drilling, Vertical deflexion, Well restoration, Television inspection.

The paper describes the main water-well drilling systems used in the United Kingdom, with some details of the tools used and the principles of operation. Limitations as regards diameter and depth for various systems and their suitability for drilling dif-ferent strata are discussed. The materials customarily employed for lining wells and for making sand screens are mentioned. The usual method of measuring the deflexion from the vertical is outlined. Methods of developing or improving the yields of wells, and inspections by television cameras are described. There is no universal economic drilling system. Particularly on repetition work it is important to use the system appropriate to the site conditions. The most interesting developments of late have been (1) reversed-circulation rotary drilling for soft unstable sediments and for hard rocks and (2) the use of air circulation instead of mud for drilling hard stable formations at relatively small diameters. Development of wells by acidizing and other means to improve the yield is worth more consideration. Many of the water-well drilling techniques are applicable to and have been used for bored piles and caissons. (Campbell-NWWA) W71-06952

PROGRESS IN THE WATER WELL CON-STRUCTION INDUSTRY, Western Well Drilling Co., San Jose, Calif.

S. T. Guardino.

Groundwater, Vol 2, No 1, p 31-34, January 1964.

Descriptors: *Water wells, *Drilling, Rotary drilling, Standards.

Identifiers: Water well design, *Water well industry, Test bore drilling.

The modern water well contractor is a combination structural engineer, mechanic, geologist and sanitarian. Contractor's skills and accumulated knowledge should be assembled within an area and used as the basis for design and water well specifications. Engineering a water well should have the primary objective of obtaining and adequate supply of potable water, with equal importance placed upon the protection of the source of supply. The drilling of a test bore should be included in the design of every water well. A properly drilled and accurately logged test bore can determine exact design features and equipment requirements. In an area where formation samples may be deceiving and where a more accurate log is required, it is possible to contract for an electric log of the test bore. When it is essential to obtain truly representative samples in an uncontaminated form, core samples may be taken as the test bore is being drilled. The water well driller should acquaint his

customer with modern construction procedures and modern water well design just as he has become aware of building codes and architectural specifications in the construction of buildings and homes. Contractors must keep pace with the achievements of technical people associated with the water well industry by self-education and incentive. The water well industry should be, and is, proud of its responsibility. (Campbell-NWWA) W71-06954

WELL DRILLING MANUAL. Koehring Co., Enid, Okla. Speedstar Div.

Enid, Oklahoma, Koehring, 1966. 72 p.

Descriptors: *Drilling, *Water wells, Drilling equipment, Wells, Water supply, Groundwater, Estimated costs, Operations and maintenance. Identifiers: Cable tool rigs, Rotary rigs, Reverse circulation drilling, Lost circulation, Fishing tools, Drill string, Rig maintenance, Bits.

This manual is a basic 'how-to-do-it' book in the sense that it goes through a step-by-step discussion of how each of the various types of water well drills operators: step-by-step procedures are discussed on how to drill a hole with each type of equipment in use. Basic fishing tools and fishing techniques for drilling tools 'lost' downhole are also explored. Because of varying geological conditions and varying needs, it is difficult to choose the best equipment to do the job. This manual can assist government and private users in the selection of the proper drilling machines. (Campbell-NWWA) W71-06956

MANUAL OF WATER WELL CONSTRUCTION PRACTICES.

Oregon Drilling Association, Inc., Portland.

Portland, Spencer Etzel Enterprises, 1968. 85 p.

Descriptors: *Drilling, *Water wells, Rotary drilling, Hydrology, Oregon, Wells, Drilling equipment, Casings, Groundwater.

Identifiers: *Water well location, Geologic con-

siderations, Safety, Cable tool construction techniques, Bailers, Grouting, Well disinfection, Well completions.

The first purpose of this Manual is to introduce young drillers to the natural resource with which they will be dealing, to the earth's crust in which water is found, to the machinery and tools drillers employ, to the practicable and permissible techniques of drilling and to the terminology of the trade. The second purpose of the Manual is to suggest sources where answers may be found to the questions likely to be encountered in Oregon's State Examination for a Drilling Machine Operator's license and a Drilling Contractor's license. It is an attempt to bridge the gulf between age and youth, age-old methods and techniques as a way to be sometimes of the property of the prop tomorrow. It is well referenced and contains many useful tables and graphs. (Campbell-NWWA) W71-06957

EFFECT OF RESEARCH ON PRESENT DRILLING COSTS,

American Association of Oil Well Drilling Contractors, Dallas, Tex. J. W. Peret.

Fourth and Fifth Annual Rotary Drilling Conference, Houston, Texas; Transactions and Minutes of the AAODC Rotary Drilling Committee for 1966-67, p 39-52. 12 tab, 24 fig.

Descriptors: *Drilling, *Drilling research, Oil industry, Rotary drilling, Drilling equipment.
Identifiers: *Drilling costs (Oil), Footage trend, Rig trend, Rig penetration trend, Average footage

The objective in this study is to present the various trends that have developed in drilling along with a

measurement of the money involved. The basic facmeasurement of the money involved. The basic factors used include the Footage Penetrated, Holes Drilled, and Rigs Used. The scope of the study covers the USA for a period of 10 years, through 1965. The trend of footage drilled has been downward, dropping from 233.9 million feet in 1956 to 181.4 million feet in 1965. The above figures, as reported to industry, include both Rotary and Cable Tool drilling. The net Rotary drilled footage for the same years is estimated to have ranged from 192.3 million feet 1955 down to 154.2 million feet 1965. This marked decline of 20% drop in domestic rotary drilled footage is one of the reasons accounting for the current oversupply of rigs available for hire. The trend of rigs has lowered from 2,683 in 1955 down to 1,384 for 1965. The trend of average footage penetrated annually per rig has improved. In 1955 the rigs on Rotating Status averaged 71,684 feet per year each while in 1965 this figure had risen to 111,424 feet per rig. This impressive rising trend of penetration capability was achieved through gains in technology. An inty was achieved through gains in technology. An in-complete list of these innovations includes im-provements in Weight-Speed programs; Hydrau-lics; muds low in viscosity, density and solids; better design and metallurgy in drill strings, bits, pumps, and rotary connections; better practices in inspec-tion, classification and grading of used drill strings and bits; along with many other advancements.
(Campbell-NWWA)
W71-06958

PRESENT STATUS OF DRILLING RESEARCH, American Association of Oil Well Drilling Contractors, Dallas, Tex.

Stanley Hutchison.

Fourth and Fifth Annual Rotary Drilling Conference, Houston, Texas; Transactions and Minutes of the AAODC Rotary Drilling Committee for 1966-67, p 34-38. 2 tab, 2 ref.

Descriptors: *Drilling, *Oil industry, Rotary drilling, Drilling fluids, Cementing.

Identifiers: *Drilling Research, Present field situation, Areas for drilling research, Incentives for drilling research, Data capture and retrieval, Rig automation, Drilling economics.

A survey of drilling research on a reconnaissance basis has recently been completed which had the major objectives of determining what was required to make progress in drilling, if there was an economically fruitful field for drilling research and development, and how this drilling research and development could best be accomplished. There was a consensus of opinion that is unlikely that new and exotic hole-forming methods and techniques will replace the rotary drilling method in the foreseeable future. Therefore, the greatest potential is in drilling as well as we already know how, and in making incremental improvements in rotary drilling methods. A number of ideas appear to offer economic research and development opportunities.
It is doubtful the present level of drilling research and development will fulfill the oil industry's requirements. The operators who have continuous drilling programs have the major economic incentives for supporting an active drilling research program. Cooperative drilling research efforts are highly desirable in order to reduce the costs and spread the risk of an individual operator. (Campbell-NWWA) W71-06960

THAI AIR BASE FLOOD CONTROL, For primary bibliographic entry see Field 04A. W71-06963

8B. Hydraulics

ANALYSIS OF EXPERIMENTS ON SECONDARY UNDULATIONS CAUSED BY SURGE WAVES IN TRAPEZOIDAL CHANNELS, Societe Grenobloise d'Etude et d'Applications

Hydrauliques (France). F. Benet, and J. A. Cunge.

Text in English and French. Journal of Hydraulic Research, Vol 9, No 1, p 11-33, 1971. 23 p, 5 fig, 1 tab, 10 ref, 4 append.

Descriptors: *Hydraulic jump, *Surges, *Waves (Water), *Unsteady flow, *Open channel flow, Open channels, Hydraulic models, Hydraulics, Turbulent flow.

Identifiers: *Open channel surges, Trapezoidal open channels.

Secondary undulations, referred to sometimes as Favre waves, are associated with surge waves in canals. In most practical cases, the amplitude of the undulations superimposed upon the surge is at a maximum near the banks. Both laboratory and field observations illustrate the two-dimensional nature of Favre waves. There is a considerable difference between the maximum water level fluctuations at the channel edges and at the center of the crosssection and, therefore, the water surface in a crosssection cannot be assumed to be horizontal. Two phenomena seem to be superimposed: Wave propagation in water of varying depth, with the wave amplitude depending on the energy which should have been dissipated by the jump; and a phenomenon depending on the initial velocity. (Knapp-USGS) W71-06478

THE LENGTHS OF STATIONARY WAVES ON FLOWING WATER,

Cambridge Univ. (England). Engineering Lab.; and

Rataafse Internationale Petroleum Maatschappij N.V., The Hague (Netherlands).
A. M. Binnie, and T. M. G. Cloughley.
Text in English and French. Journal of Hydraulic Research, Vol 9, No 1, p 35-41, 1971. 7 p, 2 fig, 8

Descriptors: *Standing waves, *Uniform flow, *Open channel flow, Critical flow, Hydraulic jump, Hydraulics, Turbulent flow, Boundary layers, Velocity, Waves (Water). Identifiers: Stationary waves.

A theoretical expression is obtained for the length of small-amplitude stationary waves on a stream in which the velocity is uniform in the upper part but diminishes linearly to zero at the bottom of the channel. The wave length is reduced by the lack of uniformity in the stream, an effect which had been noticed experimentally. (Knapp-USGS) W71-06479

TURBULENCE CHARACTERISTICS IN FREE SURFACE FLOWS OVER SMOOTH AND ROUGH BOUNDARIES,

State Univ. of New York, Buffalo; and Florida Univ., Gainesville. Dept. of Coastal and Oceano-

graphic Engineering.
Paul H. Blinco, and E. Partheniades.

Text in English and French. Journal of Hydraulic Research, Vol 9, No 1, p 43-71, 1971. 29 p, 9 fig, 2

Descriptors: *Turbulence, *Open channel flow, *Boundary layers, *Turbulent boundary layers, *Roughness (Hydraulic), Turbulent flow, Erosion, Scour, Model studies, Hydraulic models, Reynolds number, Free surfaces. Identifiers: Free surface flow.

The effects of boundary roughness and Reynolds number on the turbulence intensity in the direction of the flow were determined in an open channel flume. The results of this study suggest the possi-bility of using a universal equation relating turbulence intensities to boundary shear, kinematic viscosity and relative distance from the boundary. The relative turbulence intensity in the direction of flow with respect to the shear velocity seems to depend exclusively on the dimensionless distance from the boundary, which may be interpreted as a frictional Reynolds number. The relative intensity as a function of relative distance increases strongly with increasing bed roughness. (Knapp-USGS) W71-06480

DISTRIBUTIONS IN CURVED OPEN-CHANNEL FLOWS,

Imperial Coll. of Science and Technology, London (England). Dept. of Hydraulic Engineering; and Aleppo Univ. (Syria). Dept. of Engineering. J. R. D. Francis, and A. F. Asfari. Text in English and French. Journal of Hydraulic Research, Vol 9, No 1, p 73-90, 1971. 18 p, 6 fig, 8

Descriptors: *Vortices, *Turbulent flow, *Open channel flow, *Meanders, *Hydraulic models, Eddies, Mixing, Hydraulics, Flumes, Boundary layers, Open channels, Velocity, Currents (Water). Identifiers: Secondary flows.

Bends in rivers give rise to a spiral flow which gradually brings slow fluid originally near the bed to other positions in the cross-section. In an experimental investigation of secondary currents in sharp bends of relatively wide streams, measurements were taken of the tangential velocity at several cross-sections. The bends were of 180 deg deflection and were of rectangular section. The general equations of motion were solved using the method equations of motion were solved using the method of finite differences. The calculation is based upon a simple model which ignores the complexities of slow spiral flows, and merely relies on the mixing that is induced by the non-uniform flow in the fluid entering the bend. (Knapp-USGS) W71-06481

CONCEPT OF CRITICAL SHEAR STRESS IN LOOSE BOUNDARY OPEN CHANNELS, West Virginia Inst. of Tech., Montgomery. Dept. of

Civil Engineering.

Text in English and French. Journal of Hydraulic Research, Vol 9, No 1, p 91-113, 1971. 23 p, 9 fig, 2 tab, 12 ref, append.

Descriptors: *Reviews, *Hydraulic models, *Sediment transport, *Alluvial channels, *Bed load, Scour, Stream erosion, Shear stress, Erosion, Streamflow.

Identifiers: Critical shear stress (Scour).

The problem of defining critical flow condition associated with the initial instability of bed material particles was reviewed in relation to existing concepts. A distinct condition for the beginning of movement does not really exist, but for all practical purposes, a limiting bed shear stress for a bed material can be defined below the bed load transcert is the problem of the problem. port is of no practical importance. A family of curves can be fitted into the data which show that the bed load transport rate varies as the 16th power of bed shear stress. This 16th power correlation is consistent with that concept of critical shear stress which stipulates that a small increase in bed shear stress causes a noticeable change in bed load transport. For the professional engineer, the concept of critical shear stress or limiting shear stress is very useful, since it indicates the flow under which a natural or an artificial bed will be stable. (Knapp-USGS) W71-06482

DEVELOPMENT OF A MEANDERING THALWEG IN A STRAIGHT, ERODIBLE LABORATORY CHANNEL,

Geological Survey of Israel, Jerusalem. laakov Karcz.

Journal of Geology, Vol 79, No 2, p 234-240, March 1971. 7 p, 6 fig, 21 ref.

Descriptors: *Channel morphology, *Scour, *Sedimentary structures, *Alluvial channels, *Hydraulic models, Model studies, Flumes, Dunes, Meanders, Braiding, Sediment transport, Bed load. Identifiers: Flume models.

A preliminary, experimental study was made of the development of a meandering stream path in a straight erodible channel. Emphasis was on the visual rather than quantitative aspects of the bed deformation process. The following sequence of bed deformation leading to a development of a

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meandering stream path was observed in shallow flows along a straight laboratory channel molded in pumice: (1) appearance of far-spaced bed undulations; (2) appearance of flow-aligned scours at the leeward ends of the undulation crests; (3) growth and spread of the scours and a gradual deformation of the surrounding stream bed into a thatched at offset pattern of scours with intervening mounds; offset pattern of scours with intervening mounds; (4) growth and merging of scours along interconnecting sinuous paths; (5) rapid excavation along a preferred tortuous path and appearance of a pronounced meandering thalweg. These events may be interpreted as results of the inherent structure of the parent flow. (Knapp-USGS) W71-06485

BLOCKING EFFECTS IN FLOW OVER OBSTA-

Johns Hopkins Univ., Baltimore, Md. Dept. of

Robert R. Long. Tellus, Vol 22, No 5, p 471-480, 1970. 10 p, 11 fig, 11 ref. ESSA Grant No E22-15-69 (G).

Descriptors: *Stratified flow, *Unsteady flow, *Flow around objects, *Deflection, Diversion, Ed-Flow around objects, "Detection, Diversion, Eddies, Backwater, Hydraulic jump, Bores, Surges, Non-uniform flow, Vortices, Turbulent flow, Hydraulics, Air circulation, Winds.
Identifiers: Blocking effect (Stratified flow).

A theoretical investigation is made of the flow of two fluids over an obstacle. Particular attention is given to the upstream disturbance that occurs when the obstacle is started up from rest in a long channel. This has importance as it relates blocking phenomenon that occurs when a stratified fluid like the atmosphere moves over barriers. The results of the analysis are borne out by the experiments in the special case of disturbances at a waterair interface. The blocking that occurs is accomplished by a bore moving up ahead of the obstacle raising the upstream depth. The phenomenon is unsteady; it is also non-linear as indicated by the fact that the upstream may be disturbed even when conditions permit no infinitesimal disturbance to progress upstream. (Knapp-USGS) W71-06499

PHYSICAL PROCESSES OF SEDIMENTATION, Reading Univ. (England). Sedimentology Research

For primary bibliographic entry see Field 02J. W71-06503

SPECTRAL ANALYSIS - A PROTOTYPE STU-

Bureau of Reclamation, Denver, Colo. For primary bibliographic entry see Field 07A. W71-06511

RACE TO PLUG BURST MAIN BEFORE RAINS CAME.

Eng Contract Record, Vol 82, No 12, p 44-45, Dec

Descriptors: *Damages, *Remedies, *Repairing, Estimated costs. Identifiers: *Storm sewers.

The article describes how a municipal storm sewer section, solidly plugged with a mixture of mud and water, ruptured and was repaired. Three steps were taken to correct the damage: (1) temporary lines were laid along the surface and the mains were pumped through these surface lines; (2) drop manholes were constructed at two sides of the threatened area; and, (3) three pumps were used to by-pass the plugged section of the line. The emergency measures for the public are related, and the theoretical causes for the break are included. The cost of repair for this unexplained occurrence is given. W71-06543

ADDITIONAL INFORMATION-FAILURE OF STORM SEWER SYSTEM.

For primary bibliographic entry see Field 05G. W71-06549

British Standards Inst., London (England).

British Standard Code of Practice CP2005, 1968.

Descriptors: *Design, *Construction, *Sewers,

Legislation. Identifiers: Storm overflows, Tidal outlets, Trace effluents, Great Britain.

The Civil Engineering Code of Practice (No. 5, 1950), entitled DRAINAGE has been completely revised to incorporate new methods for the design and construction of sewers and auxiliary works. Recommendations are made regarding materials and components, basic data requirements, general design and construction of sewers, discharge of trade effluents, manholes, storm overflows, siphons, pumping stations and mains, and tidal out-falls. The relevant legislation is indicated, and methods for calculating rates of runoff are appended. W71-06552

MODEL STUDIES OF STORM SEWER DROP SHAFTS,

Sigurd H. Anderson.

St Anthony Falls Hydraulic Laboratory, Minneapolis, Technical Paper No 35, Series B, p 1-61, Dec 1961.

Descriptors: *Hydraulic structures, *Laboratories, Model studies.

Identifiers: *Drop shafts, *Storm sewers.

The Department of Public Works of the City of St. Paul, Minnesota, presently engaged in a program of enlarging their storm sewer system, is developing a drop-shaft design which will reduce the possibility of impact damage to the structure and also insure stable flow conditions in the underground interceptors. It was found that past designs required frequent inspection and maintenance at the base of the shaft to prevent failure of the structure. An experimental study led to the development of an impact-cup type of drop structure which could be effectively used to convey storm runoff waters from the surface to subterranean collecting systems with a minimum of air entrainment and a reduction in possible damage at the base of the drop. Pictures and measured sketches of the designs are included. W71-06553

UNDERWATER REVEALING, INSPECTION--SEEING

For primary bibliographic entry see Field 05G. W71-06555

SOME ASPECTS OF DEEP SEWER MAINTENANCE,

L. Goodhey

Water Pollution Control, Vol 68, No 2, p 217-221, Mar 1969.

Descriptors: *Sewers, Weirs. Identifiers: *Storm sewage, *Deep sewers.

The design and construction of deep sewers which are described are drawn from the Rochester, Chatham and Gillingham Joint Sewerage Board. It is advised to restrict the admission of storm sewage and to install storm overflow weirs only on the branch sewers. The maintenance of deep sewers as well as safety precautions, and cleaning and inspection methods are explained. For the first flush of storm sewage into the trunk sewer, a long and narrow chamber, with an overflow weir at the upstream end and an outlet into the trunk sewer from its downstream end, is constructed at a point where a branch sewer enters a trunk sewer. W71-06558

STORM DRAINAGE PRACTICES OF THIRTY-TWO CITIES

Richard A. Rogers, Kenneth R. Wright, and Elmer

L. Claycomb. J Hydraulics Div, Am Soc Civil Engrs, Vol 95, No 6, p 2195-2196, Nov 1969.

Descriptors: *Design criteria, *Storm drains, Ra-

tional formula.

Identifiers: *Urban Storm Drainage Criteria Manual.

Wright and Claycomb state that the Denver Regional Council of Governments (DRCOG) commissioned the preparation of an Urban Storm Drainage Criteria Manual in 1967. The related findings indicate that the Rational formula is often misused. They also mention that extensive research has been conducted on the subject of practical storm sewer design by the University of Missouri. W71-06560

RATIONAL 'RATIONAL' METHOD OF STORM DRAINAGE DESIGN,

J Irrigation Drainage Div, Am Soc Civil Engrs, Vol 94, No IR4, p 465-480, 1968.

Descriptors: *Storm drains, *Drainage systems, *Design, *Rational formula, *Non-uniform flow, *Computer programs, Runoff Pipes. Identifiers: *Submerged systems.

The method of a storm drainage system design is presented which utilizes the Rational Formula with a modification to allow for nonuniform runoff. The system is designed for critical periods when flow in a system or parts of a system is maximum as determined from a hydrograph of the runoff. This method is particularly suited for the design of submerged systems, and therefore, it was computerized. The results of a sample problem show larger pipe sizes than would be found when using the conventional method which adds times of flow in lines to concentration time at some arbitrary starting point. W71-06561

OPTIMIZATION IN DESIGN OF HYDRAULIC NETWORK

Bengal Engineering Coll., Howrah (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 06A.
W71-06583

HANDBOOK OF STEEL DRAINAGE AND HIGHWAY CONSTRUCTION PRODUCTS: HIGHWAY CONSTRUCTION CHAPTER 4 - HYDRAULICS.

Am Iron Steel Inst, New York, NY, p 82-141, 1967. 47 fig, 18 tab, 22 ref.

Descriptors: *Hydraulic design, *Drainage structures, *Culverts, *Design data, *Runoff forecasting, Open channels, Sewers, Design flow. Identifiers: *Sewer hydraulics.

This chapter explores the hydraulics of various drainage structures such as open channels, culverts, storm drains, and sanitary sewers, with the emphasis placed on culverts. Section I includes methods of hydrologic design and factors in drainage design. Section II involves the estimation of runoff from small areas and discusses the rational method, watershed characteristics, time of concentration, drainage area, and the Talbot and Burkli-Ziegler formulas. The hydraulics of open drainage channels such as ditches, gutters, and median swales is treated in the next section. Section IV discusses the hydraulics of sewers, including: design flow of sanitary sewers and of storm-water; hydraulic considerations for sewers; transivalues of n - the roughness coefficient in the Manning equation; determining storm sewer sizes; and the hydraulics of subdrains. (See also W71-06639) W71-06643

RANDOMLY FLUCTUATING FLOW IN CHANNEL DUE TO RANDOMLY FLUCTUATING PRESSURE GRADIENTS,

National Aeronautics and Space Administration, Cleveland, Ohio, Lewis Research Center.

Morris Perlmutter.

Available from the National Technical Information Service as N71-18629, \$3.00 in paper copy, \$0.95 in microfiche. National Aeronautics and Space Ad-ministration Technical Note NASA TN D-6213, March 1971. 31 p, 7 fig, 13 ref.

Descriptors: *Open channel flow, *Steady flow, *Unsteady flow, Markov processes, Pressure, Frequency analysis, Hydraulic gradient, Fourier analysis, Stochastic processes, Statistical methods, Mathematical studies. Identifiers: Fluctuating flow.

A randomly fluctuating pressure gradient of a stationary Gaussian Markovian form will cause a randomly fluctuating velocity to be superimposed on the steady incompressible flow in a channel. Correlations, spectra, and frequency response func-tions for the random functions are given. Random pressure signals were generated using Fourier series expansion with coefficients randomly picked from distributions whose parameters were obtained from the spectra of the pressure signal. The random velocity signals were then obtained from the pressure signal by use of the frequency response function calculated from the equation of motion. The increased power loss due to the fluctuations is given and the random pressure and velocity signals are compared for amplitude, frequency, and time lag. (Knapp-USGS) W71-06665

RIVER-COAST INTERACTION: LABORATORY

SIMULATION, Florida Univ., Gainesville. Dept. of Coastal and Oceanographic Engineering.

For primary bibliographic entry see Field 02J. W71-06697

ST. LOUIS FLOOD PROTECTION: INTERIOR

DRAINAGE, Herman M. McKinney. J Hydraulics Div, Am Soc Civil Engrs, Vol 93, No HY4, p 129-147, July 1967.

Descriptors: *Drainage programs, Comparative costs, Storm runoff, Missouri, Water pollution con-

Identifiers: *St. Louis (Mo), Sewer hydraulics.

The interior drainage considerations in the project authorization and basis for determinations of storm runoff, hydraulic gradients, sewer capacities, gate closing stages, stormwater ponding capacities, seepage, base flow, required pumping capacities, and sewer sizes are presented. In addition, the basis for schemes of plans considered, and comparative cost analysis and selection of plans are evaluated. W71-06750

ENTERPRISING PROJECT AIMS AT BRING-ING SEWER DESIGN UP TO DATE,

Mike Sumner.

Water Pollution Control, Vol 107, No 1, p 25, Jan

Descriptors: *Hydraulic design, *Sewers, Water pollution control. Identifiers: *Sewer junctions.

A joint research project on hydraulic criteria is being carried out by the Borough of Scarborough and the University of Toronto. The project specifically is concerned with finding the best design modification to eliminate flooding at sewer junctions. W71-06755

SYSTEM DESIGN, George E. Symons.

Water Wastes Eng, Vol 4, No 9, p M3-M21, Sep.

Descriptors: *Sewerage, *Sewers, *Design, *Hydraulics, *Installation, *Storage tanks, Sewage treatment, Design flow, Storm runoff, Overflow, Water pollution control, Waste water treatment. Identifiers: Combined sewers, Storm sewers.

This digest of information on sewerage systems includes definitions, explanations, and tabular data on a wide range of topics such as: sewer type classifications, considerations in sewer design, sanitary sewers, sewer hydraulics, storm and combined sewers, sewer appurtenances, and inplant piping systems. Conditions are enumerated under which sanitary sewers, combined sewers, or separate sewers should be installed. Storm sewers are recommended to relieve loads on existing combined sewers. Stormwater treatment is suggested unless an alternative can be employed such as sanitary wastes transport under pressure through small lines laid in existing combined sewers. The planning and design of storm and combined sewers is described including correct location and design capacity of such systems. Appurtenances relating to stormwater runoff, such as overflows and storm tanks, are defined and described. Storm tanks are more commonly used in combined systems in order that stormwater eventually be passed to sewage treatment works to avoid overflow of storm water into nearby bodies of water. Such tanks operate under gravity or pumping conditions. Tables, diagrams, and graphs in the digest include: sewer classification, sewer system layouts, population trends in the U.S., quantities of water and sewage flow in U.S. cities, amounts of hourly and daily sewage flow in a sample city, extreme flow rates as a function of population, filtration specifications, rates of flow using Bernoulli's, Manning's, and Hanzen-Williams' formulas, a sewer design slide rule, sewer hydraulic information, recommended minimum sewer grades, and design criteria for sewer appur-W71-06756

APPLIED FLOOD HYDROLOGY,

For primary bibliographic entry see Field 05G. W71-06773

RUNOFF FROM COMBINED RURAL AND URBAN AREAS,

For primary bibliographic entry see Field 05G. W71-06774

SOLUTION OF THE UNSTEADY ONE-DIMEN-SIONAL EQUATIONS OF NON-LINEAR SHAL-LOW WATER THEORY BY THE LAX-WEN-DROFF METHOD, WITH APPLICATIONS TO HYDRAULICS,

Royal Aircraft Establishment, Farnborough (En-

gland). M. R. Abbott.

Available from NTIS as AD-706 649, \$3.00 in paper copy, \$0.95 in microfiche. Technical Report 69179, August 1969. 14 fig, 6 ref.

Descriptors: *Open channel flow.

Identifiers: *Shallow water, One-dimensional flow, Rivers, Equations of motion, Mathematical analysis, Great Britain, Lax-Wendroff method.

An adaptation of the two-step Lax-Wendroff method is used for solving the unsteady one-dimen-sional equations of non-linear shallow water theory, including both frictional resistance and lateral inflow terms. This finite difference method is fast, accurate and simple to programme and covers the formation and subsequent history of discontinuities in the solution, in the form of bores and hydraulic jumps, without any special procedures. The behaviour of the numerical solution behind these jumps is found in the examples to be sufficiently smooth without the addition of an artificial viscous force term. A variety of illustrative examples is given, including simple cases of flood

waves in rivers, bores in channels resulting from rapid changes of upstream conditions, oscillatory waves on a super-critical stream and a simple hydrology example with a significant lateral inflow from rain. Several checks of the numerical method are included. The examples are confined to channels of uniform rectangular cross-section, but the method generalizes in a straightforward way to real rivers and estuaries in which the cross-section is non-rectangular and varies along the length of the W71-06778

EFFECT OF FREE STREAM TURBULENCE ON THE DRAG COEFFICIENT OF ANGULAR BLUNT BODIES,

Washington State Univ., Pullman. J. A. Roberson.

Paper American Society of Civil Engineers, ASCE Hydraulic Division Special Conference, Univ Minn, Aug 1970. 32 p. 18 fig, 8 ref, append.

Descriptors: *Fluid mechanics, *Turbulence, Turbulent flow, Laboratory tests, *Drag, Turbulent boundary layers, Research and development, *Flow around objects, Wind tunnels, Pressure distribution, Flow patterns, Test procedures, Reynolds number, Effects, Flow separation, Hydraulics, Scale effect. Identifiers: Drag-force, *Blunt bodies.

Tests made in a low-speed wind tunnel at Washington State University, Pullman, to study the effects of free stream turbulence on the coefficient of drag for angular bodies are described. Body shapes were tested for several conditions of free stream turbulence. Tests show that: (1) changes of the free stream turbulence intensity cause changes in the stream througher intensity cause straining in flow pattern and Reynolds stress within the flow about a body; (2) bodies having shapes such that reattachment of flow is not a factor experience an increase in the drag coefficient with increased turbulence intensity; (3) bodies for which reat-tachment or near reattachment of flow occurs with increased turbulence may experience an increase or decrease in drag coefficient with increased turbulence intensity, depending upon body shape, and pressure distribution on the sides of such bodies may change as much as 100% with a 10% change in turbulence intensity; and (4) free stream turbulence can cause unsteady dynamic forces on some body shapes. (USBR) W71-06844

WATER SUPPLY AND WASTE DISPOSAL, For primary bibliographic entry see Field 05G. W71-06879

QUANTITY OF WATER FROM RAINFALL, For primary bibliographic entry see Field 05G. W71-06881

HYDRAULICS OF WATER AND SEWER CON-DUITS,

For primary bibliographic entry see Field 05G. W71-06882

GROUNDWATER AND WELLS.

University Oil Products, St. Paul, Minn. Johnson Div.

For primary bibliographic entry see Field 04B. W71-06920

PRINCIPLES AND PRACTICAL METHODS OF DEVELOPING WATER WELLS. U.O.P., St. Paul, Minn. Johnson Div.

U.O.P. Johnson Division Bulletin No 1033, (Revised June 1968). 24 p, 23 fig.

Descriptors: *Water wells, *Groundwater, Wells, Hydraulics, Screens, Drawdown, Hydraulic gradient, Well capacity, Sands, Gravels.

Group 8B—Hydraulics

Identifiers: *Well hydraulics, Over-pumping, Backwashing, Surge plungers, Compressed air, High velocity jetting, Well design, Bridging.

Water-well development and the importance of well screen selection have occupied the attention of many water well drillers for the past several decades. The well screen is the intake portion of the well structure for a well that obtains water from a water-bearing sand. The well screen allows water to enter the well freely, prevents sand from enter-ing with the water, and serves as a structural support for the loose formation material. By experience over the years, drillers found that when the well screen openings are so small as to retain almost all the sand, the yield of the well is limited because adequate development of the formation cannot be done. They also found that too large openings permit the removal of too much of the formation resulting in settlement of overlying materials, or incomplete stabilization of the formation. Well screen openings of the right size permit development to the proper extent. This produces the desired results - good well efficiency and sand-free water. The development of wells by 'overpumping' and 'backwashing' and with surge plungers, compressed air, and with high velocity jetting is also discussed in detail. (Campbell-NWWA) W71-06944

TAKING REPRESENTATIVE FORMATION

U.O.P., St. Paul, Minn. Johnson Div.

U.O.P. Johnson Division Bulletin No 638-S, (Revised December 1967). 2 p.

Descriptors: *Sampling, *Rotary drilling, Data collections, Drilling fluids.

identifiers: Heaving, *Formation analysis, Drive-core sampling, Hydraulic drilling methods, Han-dling formation samples.

Much of the success of a completed water well depends upon the degree of care exercised in obtaining formation samples for analysis - a responsibility which lies directly with the driller. The right well screen for a given water-bearing formation can be recommended and provided by the screen manufacturer only when the samples are representative of the various strata in the formation. Correct labeling of samples, full and accurate information describing water levels, depths, methods of construction to be used and the amount of water wanted are also essential. Care and good judgment, plus observance of a few simple rules, are the critical items in obtaining formation samples for analysis. (Campbell-NWWA)
W71-06945

WELL POINT SYSTEMS. U.O.P., St. Paul, Minn. Johnson Div.

U.O.P. Johnson Division Bulletin No 467D, (Revised March 1969). 9 p, 11 fig.

Descriptors: *Well points, *Dewatering, *Water wells, Water table, Groundwater, Well screens, Water supply, Screens. Identifiers: *Well spacing, Screen length, Piping and connections, Typical irrigation systems, Dewatering systems, Depth of setting.

Well-point systems or suction-lift wells, can supply large quantities of water economically, where conditions are favorable. Three conditions are necessary. The water table must be within a few feet of the land surface to permit pumping from the wells by suction lift; a good stratum of water-bearing sand and gravel must be found at depths of 20 to 50 feet; and the wells themselves must be highly efficient. Well-point systems find extensive practical use in four fields: (1) to obtain water for irrigation; (2) to obtain water for muncipal or industrial purposes; (3) to temprarily dewater construction sites in wet ground; (4) to permanently lower the water table over an area for special reasons. The first two of

these applications put the water to beneficial use. The third and fourth are drainage measures where the groundwater is carried away and wasted after being pumped from the wells. The operating principles and the installation details of well-point systems to supply water for irrigation or other uses are described. The fundamentals of dewatering are also discussed. (Campbell-NWWA)
W71-06948

TESTING WATER WELLS FOR DRAWDOWN AND YIELD

U.O.P., St. Paul, Minn. Johnson Div.

U.O.P. Johnson Division Bulletin No 1243, (Revised April 1967). 8 p, 2 tab, 8 fig.

Descriptors: *Water wells, *Drawdown, Specific

yield, Pumps, Static level.
Identifiers: *Pumping level, *Measuring water levels, Orifice meter, Weirs.

No matter what the size of a well or the quantity of water it will yield, if it is to be equipped with a permanent pump to operate at the highest efficiency, it should be accurately tested for drawdown and yield before the pump is purchased. Buying a pump without such a test is a good deal like buying a 'pig in a pole.' Many times high pumping costs and unsatisfactory pump performance have been errone-ously charged to the well. In these cases an accurate test of the well in advance of the pump purchase would have more than paid for itself in the first cost of equipment and later on in operating costs. There are many ways to test a well for capacity, some of them good and some bad. If a well is important enough to be tested for capacity on completion, it is essential that it be tested accurately by the use of approved measuring devices and standard methods. Furthermore, to avoid confusion and misunderstandings, there must be agree-ment on and understanding of the terms commonly used in making capacity test of wells. It is the purpose of this bulletin to describe the most accurate and inexpensive methods of determing the actual yielding capacity of a finished well. Principal terms in use are discussed. (Campbell-NWWA) W71-06949

HYDRAULIC FRACTURING,

G. C. Howard, and C. R. Fast.

New York, Society of Petroleum Engineers of AIME, 1970. 210 p.

Descriptors: *Hydraulics, *Oil industry, *Aquifer characteristics, *Injection wells, Cavitation, Flow characteristics, Hydraulic engineering, Hydraulic properties, Fluid mechanics, Acidizing, Cementing, Identifiers: *Hydraulic fracturing, *Deep disposal wells, Fracture area, Fracturing fluids and additives, Propping agents.

Hydraulic fracturing is a method for increasing well productivity by fracturing the producing formation and thus increasing the well drainage area. This monograph is designed to be a thesis on hydraulic fracturing covering the state-of-the-art from the theory and technique of hydraulic fracturing to the application of nuclear energy as a means of cracking the reservoir rock and forming rubble. Hydraulic fracturing is based on the fact that injection pressure decreases when water, acid, cement or oil is pumped into a formation at high rate and at a high initial pressure. This work has considerable value in deep well liquid waste disposal applications and provides the practicing engineer with a source of information that will aid in judging the relative merits of various hydraulic fracturing treating procedures and the results to be expected from such methods. (Campbell-NWWA)

SOURCE WATER WELL DESIGN AND EFFI-

U.O.P., St. Paul, Minn. Johnson Div. R. L. Schreurs.

Symposium on Treatment and Control of Injection Waters, Division of Production, American Petrole-um Institute, Anaheim, California, November 1966. 18 p, 2 tab, 8 fig, 16 ref, 3 append.

Descriptors: *Water wells, *Drilling, *Oil industry, Specific capacity, Drawdown, Rotary drilling.
Identifiers: *Water well hydraulics, Damage ratio, *Water well design.

Many cheap source water wells actually can be expensive if they are inefficient and are produced for long periods of time. It is important to have effiwater wells so as to reduce the required number of wells and to minimize power costs. Several methods of determining the efficiency of wells as hydraulic structures are described. The wells as hydraulic structures are described. Ine damage ratio of a well is approximately related to the efficiency. Water well designers use an average inlet velocity of about 0.1 foot per second to minimize well losses, frequency of well development, and to prolong well life. Special terms are defined and case histories cited. Water well design and construction determine well efficiency. Important foctors to be expected as a the time of any iffer. tant factors to be considered are the type of aquifer whether consolidated or unconsolidated, the length, the location and type of screening device, and the effectiveness of development. The petroleum industry and the water-well industry would benefit by a greater exchange of theoretical and practical information. (Campbell-NWWA) W71-06951

RAIN-GAUGING PROGRAM TO PROVIDE GUIDE TO STORM SEWER DESIGN, Harvey W. Duff, Russ L. Tobey, and George C. C.

Hsieh

Water Sewage Works, Vol 116, No 11, p 420-424, Nov 1969.

Descriptors: *Rain gages, *Data collections, *Storm drains, *Design criteria, *Electronic equipment, Computers.
Identifiers: *Rain data, *Storm sewers, *Seattle,

Washington.

The Sewage and Drainage Section, Design Division of the Seattle, Washington, Engineering Department, is conducting a rain gaging program to provide sufficient precipitation data and storm data for urban-water studies for the purpose of determining a more realistic basis for the design of storm drain systems. Data for the program are obtained from electronic instruments and handled by a computer. It is estimated that only 0.2 percent of the possible data covering a four-year period is missing. W71-06964

8C. Hydraulic Machinery

ORGANIZING AND PLANNING FOR SEWER MAINTENANCE,

Glen J. Hopkins, and Don Hurlbert. J Water Pollution Control Fed, Vol 39, No 2, p 230-239, Feb 1967

Descriptors: *Maintenance, *Repairing, Sewerage, Gate control, Missouri.

Identifiers: Storm sewer valves, Sewer separation, Kansas City (Mo).

The sewer maintenance program devised by the Maintenance Division of the Department of Pollution Control, Kansas City, Mo., is geared toward public service in the quick repair of damaged sewers, whatever the cause. This program also done with saver and catch basin depairs generally deals with sewer and catch basin cleaning, sewer malfunctions and connections, and preventive maintenance. The sewer system includes a number of gate and sluice gate valves on storm sewers that must be closed in times of flooding. In the case of overloaded sewers, if stormwater lines are found to be connected to sanitary sewers, the Maintenance Division requests that the two lines be disconnected. W71-06559

Hydraulic Machinery—Group 8C

HANDBOOK OF STEEL DRAINAGE AND HIGHWAY CONSTRUCTION PRODUCTS: CHAPTER 7 - INSTALLATION INSTRUC-

Am Iron Steel Inst, New York, NY, p 160-183.

Descriptors: *Steel structures, *Installation.
Identifiers: *Corrugated steel, *Installation methods, Installation procedure.

Because of their strength, light weight, and resistance to fracture, corrugated steel structures can be installed rapidly, easily, and with the least ex-pensive machinery. The first part of this chapter outlines the importance of good installation and the advantages of using corrugated steel in installation procedures. Other subsections discuss: preparation of the base, assembly of pipe culverts and sewers, vertical elongation of corrugated steel pipe, and backfilling. Entire sections are devoted to jacking, boring, lining, and bridge filling. (See also W71-06639) W71-06646

HANDBOOK OF STEEL DRAINAGE AND HIGHWAY CONSTRUCTION PRODUCTS: HIGHWAY CONSTRUCTION CHAPTER 9 - SEWERS.

For primary bibliographic entry see Field 08A. W71-06647

OVERVOLTAGES AND INSULATION COORDINATION ANALYSIS AND APPLICATION FOR 735 KV,

Hydro-Quebec (Canada).
G. A. Baril, M. B. Guertin, and J. Parent.
Paper 33-09, CIGRE International Conference
Large High Tension Electric Systems, Paris,
France, Aug-Sep, 1970. 11 p, 4 fig, 3 tab, 8 ref.

Descriptors: *Extra high voltage, *Transmission lines, *Switching surges, Transmission (Electrical), Substations (Electrical), Test results, *Overvoltage, *Electrical insulation, Network analysis, Shunt reactors, Foreign research, Circuit breakers, Coordination, Ultra high voltage, Flashover, Electric

Identifiers: Canada, Manicouagan-Outardes (Can).

Results of switching overvoltage studies performed on a transient network analyzer for Manicouagan-Outardes and Churchill Falls 735-kv transmission systems are presented. Power-frequency overvoltages were considered during the studies. The results are analyzed to determine effects of various parameters on the switching surge overvoltages, and conclusions are applied to the insulation adopted for the lines. Based on international standards and recent technical achievements, the evolution of insulation coordination for the 735-kv system is examined. An identical procedure is applied to the evaluation of transmission line and substation insulation for 1000 kv and above. Reducing power-frequency overvoltages to a level lower than the maximum switching surge overvoltage will allow full use of surge diverters, thus ensuring adequate protection and acceptable insulation levels. (USBR) W71-06835

UNDERGROUND POWER TRANSMISSION, Ion Physics Corp, Burlington, Mass.

P. H. Rose. Science Vol 170, No 3955, p 267-273, Oct 1970. 7 p, 7 fig, 1 tab, 24 ref.

Descriptors: Cryogenics, *Transmission (Electrical), Costs, Economics, Aesthetics, Electrical insulation, Electric power losses, Bibliographies, Public opinion, Superconductors, Alternating current, Direct current, Research and development, Converters (Electrical), Dielectrics, Transmission loss. Identifiers: Gas-pressure cables.

Public opinion will override economic arguments for future underground transmission. Providing more electrical power and satisfying higher aesthetic standards will be expensive. Many technical problems must be solved for underground cables. Resistive losses causing cable temperature to rise, charging current of a-c cables resulting in critical lengths for power transmission, and insulation problems are only a few of the areas where much research is needed. Underground cables can be inresearch is needed. Officerightenia canes can be stalled in trenches in some places, and in other cases service tunnels will be required under congested areas. Cryogenic cables cooled by hydrogen are being investigated; additional research is needed to assure safe installation in cities. Many questions of underground transmission are discussed and some data are given on research being conducted. (USBR) W71-06836

IMPROVEMENT OF HYDRO-ELECTRIC SCHEMES BY HYDROMECHANICAL INVESTIGATIONS AND SCALE MODEL EXPERI-

Karlsruhe Univ. (West Germany). For primary bibliographic entry see Field 06B. W71-06845

RELAXATION OF INITIAL STRESSES IN BOLTED CONNECTIONS OF HYDRAULIC UNIT ROTORS DURING INTERMITTENT LOADS.

Bureau of Reclamation, Denver, Colo. P. A. Pavlov, A. U. Gugov, and G. V. Isaev. Available from NTIS as PB-193 627T, \$3.00 in paper copy, \$0.95 in microfiche. Bureau of Reclamation Translation No. 701, Denver, Oct 1967. 11

Descriptors: *Hydraulic turbines, *Impellers, *Hydraulic systems, Stators, Failure (Mechanics). Identifiers: Bolted joints, Relaxation time, USSR, Translations.

With the increasing size and weight of modern high-power hydroturbine units, the bolted connections of the rotors to the shaft become one of the prime areas on which the reliability of the unit depends. Because of a failure of the bolted connection of a runner to a turbine shaft, the Leningrad Metalworks devised test procedures and equipment to investigate the relaxation of the initial stresses in bolted connections of hydraulic units. The equipment and procedures are described and graphs showing the results of the tests are given. Conclusions are: (1) Relaxation of initial stresses in the bolts is mainly due to residual stresses in the threads growing in proportion to the number of cy-cles of changes in live load. (2) Degree of relaxation is reduced in proportion to the increase in initial torque. (3) The basic cause of the failure investigated was insufficient torque of the bolts, which lead to intensive relaxation of the initial stresses corresponding to an increase in the additional stresses due to the action of external loads and finally to fatigue.

DESIGNING HYDRAULIC TURBINE PARTS FOR STRENGTH.

Bureau of Reclamation, Denver, Colo. A. Ya. Aronson, A. U. Bugov, V. M. Malyshev, I. A. Skrylev, and G. Kh. Frank-Kamenetskii. Available from NTIS as PB-193 619T, \$3.00 in paper copy, \$0.95 in microfiche. Bureau of Reclamation Translation No 687, Denver, Colo, Aug 1967. 44 p. Translated from Izdat. 'Mashinos-troenie,' Moscow-Leningrad, p 303-328, 1965.

Descriptors: *Hydraulic turbines, *Hydrodyamics, *Hydraulic systems, Structural behavior, Deforma-

Identifiers: Turbine parts, Structural shells, USSR, Translations.

Leningrad Metalworks engineers have developed a method of calculating stress conditions in metal spiral cases based on their experimental investiga-

tions and study of shell structures for different turbine components. The method uses the principle of superposition of stress conditions of the: (1) joint of spiral case with speed ring; (2) region somewhat removed from the speed ring, (2) region comewhat removed from the speed ring, (3) joint between steel sheets of different thicknesses, (4) transition zone from free shell to concrete embedment, and (5) end of the ribbing. Meridional forces are calculated from the membrane theory of torus-shaped shells. For moment and horizontal forces where the spiral attaches to the speed ring, the latter can be considered as a rigid torus-shaped shell or, for welded spiral cases, an imaginary conical shell can be substituted and equations for deformation of conical shells used. For computing different types of ribbing depending on stress distribution, change of moment, and boundary stresses. Experiments show that stresses are distributed very unevenly in each section, the greatest being where the spiral is joined to the speed ring bands. Where the lower part is embedded in concrete, stress inequality appears only in the upper band. (Translator)

APPROXIMATE CALCULATION OF THE NATURAL FREQUENCIES OF VIBRATION OF RUNNERS OF FRANCIS HYDRAULIC TUR-

Bureau of Reclamation, Denver, Colo. A. Ya. Aronson, M. M. Mishin, and D. S. Moskvin. Available from NTIS as PB-193 631T, \$3.00 in paper copy, \$0.95 in microfiche. Bureau of Reclamation Translation No 707, Jan 1967. 11 p, 1 tab, 4

Identifiers: *Francis turbines, Foreign design practices, Turbine parts, *Natural frequency, tions, *Hydraulic turbines, *Turbine runners, Turbine blades, Digital computers, *Mathematical analysis, Elasticity, Elastic deformation, Rigidity, Structural analysis, Structural behavior, Flexible foundations, Rings, Resonance, Rotation, Matrix algebra, USSR, Approximation method, Elastic foundations, Matrix methods, Structural, Leningrad Metworks, USSR.

Since the natural vibration frequencies of Francis hydraulic turbines must be determined during design, and the present method of calculation used at the Leningrad Metalworks in the USSR is long and cumbersome, approximate formulas were developed for calculating these frequencies, fully satisfactory for an evaluation of the several preliminary design variants of the runner. Calculating and test work in this field have established the fact that the runner band vibrates either as a ring or is displaced as a solid body during vibration of the runner system. Alternation of vibrational frequencies and modes is involved later in the actual design of the runner; so, at this stage, considering that the band vibrates as a ring and the mass of blades does not substantially affect the frequency, it is satisfactory to assume that when the number of blades is large, the action on the band can substitute for the action on any equivalent elastic foundation. Thus, the problem is reduced to an examination of vibrations of a ring on an elastic foundation. This is valid only for the several primary modes. Sample calculations are given, the results of which compare favorably with test values of frequencies. W71-06937

THE EFFECT OF CAVITATION TYPE ON THE FORM OF HYDROTURBINE SEPARATION CHARACTERISTICS,

Bureau of Reclamation, Denver, Colo.

L. S. Shmuglyakov.

Available from NTIS as PB-193 626T, \$3.00 in paper copy, \$0.95 in microfiche. Bureau of Reclamation Translation No 699, July 1969, 10 p, 3 fig, 9 ref. Translated from: Energomashinostroenie No 1, p 25-27, 1963.

*Cavitation, *Hydraulic turbines, *Flow separation, Flow characteristics, Hydraulic machinery, Water, Physical properties, Laboratory tests, Flow patterns.

Field 08-ENGINEERING WORKS

Group 8C—Hydraulic Machinery

The form of hydroturbine separation characteristics, types of cavitation and the interrelations between the separation characteristics of cavitation types are analyzed. Methods of investigating cavitation based on the physical properties of the flow are compared, and critical states during cavitation are discussed. Restrictions imposed on laboratory stu-dies of cavitation are noted. Applications of cavitation studies in monitoring the operation hydraulic machines at hydroelectric power plants are considered. It is concluded that all the procedures recently developed under laboratory and natural conditions are applicable in more exact analysis of cavitation operation conditions.

W71-06940

MECHANIZED SURFACE IRRIGATION SYSTEMS FOR ROLLING LANDS, California Univ., Davis. Dept. of Water Science

and Engineering.
For primary bibliographic entry see Field 03F.
W71-07050

8D. Soil Mechanics

GRAIN SIZE, MINERALOGY AND CHEMIS-TRY OF A QUICK-CLAY SAMPLE FROM THE ULLENSAKER SLIDE, NORWAY, San Diego State Coll., Calif.; and Oslow Univ.

(Norway). Inst. of Geology. For primary bibliographic entry see Field 02J.

W71-06464

MOLE TUNNELING RESEARCH ADVOCATED.

Civil Eng, Vol 37, No 8, p 48-49, Aug 1967. 1 diag.

Descriptors: *Tunneling, *Tunnels, *Comparative

Identifiers: *Mole.

Dr. Walter Hibbard, Jr., Bureau of the Mines Director, recently emphasized the need for more research and development on mechanized tunneling. There is a growing demand for tunnels for the following purposes: subways, utilities, transmission lines, mining, and urban freeways. Needs in each of these areas are discussed as are advances already made with the mole borer. Savings in the billiondollar range are possible with advanced tunneling procedures. In addition to pefecting moles, guidance control, placement of lining, and methods for the transportation of muck out of the tunnel must be developed. W71-06628

THE INFLUENCE OF THE SOIL-FORMATION PROCESS ON THE COMPOSITION AND PRO-PERTIES OF THE DEPOSITS OF THE SEASONALLY FREEZING AND SEASONALLY THAWING LAYERS.

Cold Regions Research and Engineering Lab., Hanover, N.H.

For primary bibliographic entry see Field 02C.

COMPUTING THE FORMATION OF ICE IN-TERLAYERS IN FREEZING MOIST SOIL.

Cold Regions Research and Engineering Lab.,

Hanover, N.H. V. G. Melamed.

Available from NTIS as AD-711 874, \$3.00 in paper copy, \$0.95 in microfiche. Translation of Moscow Gosud Univ Merg Issledovaniyz VYP6, p 23-37, 1966. CRREL Translation, 1970. 11 p.

Descriptors: *Soil properties, *Soil physics, *Freezing, Moisture, Ice melting.

Identifiers: Interfaces, Integration, Phase studies, USSR. Translations.

An equation is derived which represents an essentially new condition of ice formation in the soils

penetrated by frost, establishing the nature of the freezing, linking the dynamics of the temperature fields in both zones and the rate of the freezing front's advance with the dynamics of a moisture

W71-06787

PROBLEMS IN THE THEORY AND PRACTICE

OF ARTIFICIAL FREEZING OF SOIL, Cold Regions Research and Engineering Lab., Hanover, N.H.

Kh. R. Khakimov

Available from NTIS as AD-711 891, \$3.00 in paper copy, \$0.95 in microfiche. 178 p, 98 ref.

Descriptors: *Freezing, *Soil stabilization, *Soil properties, Underground structures, Soil stability, Ice, Heat transfer, Soilwater movement, Deforma-

Identifiers: Hygroscopicity, *Artifically frozen

Physical processes occuring in the freezing of soils; Movement of water in the liquid phase in a freezing soil and deformations of the soil during a freezing around a pipe; Temperature regime of freezing: Consideration of the effect of filtration flow on the process of the closing of the ice and soil cylinders. W71-06791

ANALYSIS OF SOIL MOVEMENT AROUND A DEEP EXCAVATION,

Woodward-Clyde-Sherard and Associa Oakland, Calif.; and California Univ., Berkeley. C-Y Chang, and J. M. Duncan.

Proc American Society of Civil Engineering Journal of Soil Mechanics and Foundation Division, Vol 96, No SM5, p 1655-1681, Sept 1970. 27 p, 20 fig, 2 tab, 25 ref, 2 append.

Descriptors: *Cut slopes, *Excavation, Failure (Mechanics), *Slope stability, Soil engineering, *Soil mechanics, Stress, Soil properties, Soil stability, Soil tests, *Movement, Deformation, Rebound, Strain, Bibliographies, Analysis, Behavior, Instru-mentation, *Finite element method, Computer applications, Undisturbed soils.

Large soil movements in the 160-ft-deep excavation for the Buena Vista Pumping Plant in California prompted an investigation to determine if the movements were indicative of impending failure. The investigation consisted of: (1) conducting laboratory tests on undisturbed soil specimens to determine the strength and nonlinear properties of the soil; and (2) performing finite element analyses using the nonlinear soil properties to calculate soil movements and stresses at the end of excavation. Results of the analyses agreed well with the observed behavior of the excavation with regard to magnitude of soil movements and development of regions of local failure. Calculated stresses indicated that the soil movements were not indicative of impending failure. The case study shows that nonlinear finite element analyses, together with field instrumentation observations, form an effective means of investigating complex soil an effec-ing problems. Has 25 references. (USBR) W71-06837

OBSERVATIONAL DATA ON GROUND MOVE-MENTS RELATED TO SLOPE INSTABILITY. Shannon and Wilson, Seattle, Wash. S. D. Wilson.

Proceedings American Society of Civil Engineers, Journal of the Soil Mechanics and Foundation Division, Vol 96, No SM5, p 1519-1544, Sept 1970. 26 p, 27 fig, 8 ref, append.

Descriptors: Deformation, Excavation, Failure (Mechanics), Field tests, Field data, Measuring instruments, Shear stress, *Slope stability, Stability, Soil mechanics, *Landslides, Displacements, Slopes, Movement, Earth movements, *Clays, Clay shales, Cuts, Fills, Slope stabilization, Failure surIdentifiers: *Progressive failures, *Terzaghi Lecture, Earth slides, Remedial treatment.

Data from field measurements that verify the progressive nature of landslides resulting from excavations at the toe of slopes in overconsolidated highly plastic clays and clay shales are presented. The data agree with generally accepted hypotheses concerning the mechanism of such progressive failures. Distribution of such movements changes with time, and total movements and velocities must be reviewed to understand the failure process. Horizontal movements resulting from construction of embankments on soft clays are progressive and similar to those resulting from cuts in overconsolidated clays. These movements often extend well beyond the toe of the embankment except when the fill is placed on a stiff layer overlying soft materials. Several progressive slides were stabilized by corrective treatment, including cylinder pile retaining walls, underground concrete buttresses, and slope flattening. Analysis of field observational data leads to a better understanding of the mechanism of failure and ultimately may lead to improved methods of stability analysis. (USBR) W71-06838 by corrective treatment, including cylinder pile

ELASTIC ANALYSIS FOR BEHAVIOR OF ROCKFILL,

Bechtel Pacific Corp. Ltd., Melbourne (Australia). N. O. Boughton.

Proc American Society of Civil Engineers, Journal of Soil Mechanics and Foundation Division, Vol 96, No SM5, p 1715-1733, Sept 1970. 19 p, 12 fig. 2 tab, 9 ref, 2 append.

Descriptors: Elastic theory, Computation, *Structural behavior, Dams, *Rockfill dams, Rock properties, Deformation, Rocks, Soil mechanics, Elasticity (Mechanical), Shear tests, Leakage, Strain, Stress, Seepage, Impervious membranes, Dam design, Settlement (Structural), *Dam facings, Computer applications, *Finite-element method, Triaxial tests. Identifiers: Concrete slabs.

All concrete-faced rockfill dams higher than 300 ft have had serious leakage problems when first filled. In attempts to determine causes and to provide a rational basis for design, finite-element procedures are applied to rockfill dams with concrete faces. The application requires knowing the tangent elastic properties of rockfill at each state of stress in the analysis. The properties are determined from triaxial test results on several different rockfill materials, and stress-history dependent values for Young's Modulus and Poisson's Ratio are obtained. As a check on the validity of this procedure, the elastic analysis with stress-history dependent parameters is applied to confined compression and direct shear tests; consistent results are obtained in each case. Application of finite-element procedures using these elastic parameters to rockfill dams indicates that high tensions exist around the perimeter of the concrete face, and that the face has a considerable influence on the deformations of the underlying rockfill. (USBR) W71-06840

A NEW TECHNIQUE FOR SOIL STRAIN MEA-

E. T. Selig, and O. H. Grangaard, Jr.
Materials Research and Standards, Vol 10, No 11, p 19-21, 35, Nov 1970. 5 p, 12 fig, 6 ref.

Descriptors: Soil engineering, Soil mechanics, *Measuring instruments, *Soils, Soil tests, Strain, *Strain measurement, Embedded instruments, Field tests, Laboratory tests, Sensors, *Strain gages, Instrumentation, Calibrations, Dynamic response, Volume change, Measurement. Identifiers: Static behavior.

A new instrumentation system has been developed for measuring static and dynamic strains in soil. The strain gage system is battery powered and portable for use in the field and laboratory. The

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principle of operation involves the mutual in-ductance coupling between 2 coaxial soil sensors embedded within the soil. The coupling is extremely sensitive to the distance between sensors, and may be directly related to strain. Essential elements of the strain gage system are: (1) a pair of rugged disk-shaped sensors embedded in the soil in near parallel and coaxial orientation separated by a distance over which strain is to be averaged; and (2) a portable instrument package containing driving, amplification, balancing, calibration, and readout controls. The sensors are free-floating in the soil to provide minimal interference with the soil movements, a unique feature. Accuracy of readings is not affected by normal changes in soil composition or moisture content. Advantages, limitations, and examples of application of the system are presented. Studies show that the technique is simple, reliable, and versatile. (USBR) W71-06841

A STUDY OF THE HARDNESS OF ICE,

Cold Regions Research and Engineering Lab., Hanover, N.H.

For primary bibliographic entry see Field 02C. W71-06924

COMPUTER ORIENTED STABILITY ANALY-SIS OF RESERVOIR SLOPES, Purdue Univ., Lafayette, Ind. School of Civil En-

Purdue Univ., Larayette, Ind. School of Civil Engineering.
R. K. Carter, C. W. Lovell, Jr., and M. E. Harr.
Available from National Technical Information
Service as PB-198 432, \$3.00 in paper copy, \$0.95
in microfiche. Purdue University Water Resources
Center, Technical Report No 17, January, 1971.
120 p. 14 fig, 5 tab, 19 ref, append. OWRR Project
A-009-IND (1).

Descriptors: *Slope stabilization, Bank stabilization, *Slope stability, *Reservoir, Embankments, Landslides, Programming languages, Steady flow,

Bearing strength.
Identifiers: Taylor solution, Bishop method,
Modified bishop method, Critical sharing surface.

The purpose of the research was to develop a computer-assisted system of stability analysis for specific reservoir slopes. The versatility of the developed programs includes accommodations for variable ground surface and profile characteristics, both uniform and concentrated external boundary loadings, spatial variations in water pressure, and irregular as well as circular shaped failure surfaces. Several limiting equilibrium analyses by methods of slices have been reviewed. One of these, the modified Bishop technique, previously considered applicable only to circular failure surfaces, was modified to include irregular shaped surfaces. The programs have been written in elementary Fortran IV language. There are currently five main programs and eleven integrated supporting routines. Conversion of the programs to small computer systems is considered highly practical. (Wiersma-Purdue) W71-07058

8E. Rock Mechanics and Geology

NOMOGRAMS FOR CALCULATING THE DEPTHS OF PERENNIAL FREEZING OF ROCKS AND THERMAL CYCLES WITHIN

Cold Regions Research and Engineering Lab., Hanover, N.H.

. A. Kudryavtsev, and V. G. Melamed. Available from NTIS as AD-711 881, \$3.00 in paper copy, \$0.95 in microfiche. Trans of Merzlot-nyge Isseldovaniyz, Vol 7, p 30-37, 1967. CRREL Translation, 1970. 7 p.

Descriptors: *Permafrost, *Thermal properties, *Rock properties, Thermal conductivity, Freezing, Thawing, Melting, Numerical analysis. Identifiers: *Nomographs, Phase studies, USSR,

In a collection of permafrost reports equations were proposed for calculating the depths of the perennial freezing and thawing of layers of rocks. and of the heat exchanges taking place in them. For a calculation of the heat exchanges Q (kcal) in the layer of rocks, pressing through the surface of the Earth during perennial freezing, formulas are given. W71-06789

SOME INFLUENCES OF GEOLOGY AND MIN-ING UPON THE THREE-DIMENSIONAL STRESS FIELD IN A METAMORPHIC ROCK

Geological Survey, Denver, Colo.; and Arizona

Univ., Tucson.
T. C. Nichols, Jr., F. T. Lee, and J. F. Abel, Jr.
Engineering Geology (Bull AEG), Vol 6, No 2, p
131-143, Fall, 1969. 13 p, 7 fig, 8 ref.

Descriptors: Rock excavation, *Rock mechanics, Stress, Measuring instruments, *Stress distribution, Geology, Field tests, Strain, Mining, *Tunnels, Residual stress, Rocks, Three-dimensional, Displacements, Engineering geology, Stress concentration, Deformation, Rock pressures, Probes (Instruments), *Underground openings, In situ tests. Identifiers: *Borehole deformation gage, Subsurface openings.

A solid inclusion borehole probe for determining 3dimensional stress changes in rock has been developed by the Geological Survey in connection with an applied rock mechanics research project. Preliminary findings using the probe to determine the influence of excavation procedures, geologic conditions, and the pre-existing stress field upon the changing stress field in rock around an active opening are presented. Results show that major geologic structural features such as foliation. prominent joint sets, and faults have a major influence on redistribution of rock stress around an actively excavated opening, and excavation operations and original rock stresses can significantly influence stress redistribution in a manner that commonly cannot be explained by an elastic analysis.
(USBR) W71-06839

EARTHQUAKE RESPONSE OF ARCH DAMS, Assam Engineering Coll., Gauhati (India); and Southampton Univ. (England). For primary bibliographic entry see Field 08A. W71-06843

HYDRAULIC JET DRILLING, Esso Production Research Co., Houston, Texas. William C. Maurer, and Joe K. Heilhecker.
Society of Petroleum Engineers, AIME, Preprint
No SPE 24-34, p 213-224, 1969. 6 tab, 17 fig. 15

Descriptors: *Drilling, *Rock mechanics, Rock Descriptors: *Drilling, *Rock mechanics, Rock properties, Drilling equipment. Identifiers: *Drilling research, Novel drilling techniques, Hydraulic jet drilling, Rock strength, Berea sandstone, Indiana limestone.

As a result of a detailed survey of over 25 novel drilling techniques, a laboratory study of hydraulic jet drilling was made. In initial tests, a cannon was used to fire 1.45-gal water pulses at rocks at pressures up to 25,000 psi. These tests showed that a threshold nozzle pressure must be exceeded before hydraulic jets will drill rock. Water jets having diameters of 0.2 to 1 in. drilled holes with diameters ranging from 0.8 to 4 in. in sandstone and limestone. These holes, which were 1 to 3 in. deep, were drilled in 0.02 to 0.2 seconds. These tests showed that water jets can effectively drill sedimentary rocks. Following these tests, a 2-in. diameter hydraulic jet drill was tested in a laboratory rig. A high pressure pump was used to pump water continuously through this drill at pressures up to 13,500 psi. This drill penetrated Carthage marble at 180 ft/hour, Indiana limestone at 280 ft/hour and Berea sandstone at 300 ft/hour. These tests showed that a full-scale hydraulic jet drill (3,000 hp) should drill 8 in. diameter holes in average-strength sedimentary rocks at rates of 200 to 300 ft/hour. These high drilling rates show that hydraulic jet drills have high potential for drilling oil wells economically. This paper is exceptionally well illustrated and well referenced. (Campbell-NWWA)

THE EFFECT OF HEAT ON SOME MECHANI-CAL PROPERTIES OF IGNEOUS ROCKS,
Gulf Research and Development Co., Pittsburgh,

A. B. Barbish, and G. H. Gardner.

Society of Petroleum Engineers Journal, December 1969, p 395-402. 2 tab, 13 fig. 5 ref.

Descriptors: *Rock properties, *Rock mechanics, *Drilling research, Aquifer characteristics, Gab-

Identifiers: *Elastic moduli, Weibull parameters, Point penetration, Microcracks, Bending strength, French Creek (Pa).

The elastic moduli of most igneous rocks are greatly reduced by heating and depend, at room temperature, on the highest temperature to which they have been previously heated. This phenomenon was investigated by measuring velocity, attenuation, bending strength, and point penetration as functions of moisture content, porepressure, confining pressure, and highest previous temperature for a series of gabbro samples from French Creek, Pa. Bending strength and point pentration tests indicated that the microcracks introduced by heating to temperatures up to 1000 deg C have few cracks and are very uniformly distributed. Though the porosity was only about one percent, the attenuation of sound waves was found to be very dependent on moisture content. The attenuation was also found to increase greatly when the pore pressure and confining pressure were increased equally, even though the elastic moduli remained almost constant during the changes. The Weibull parameters were measured, but the uniformity of the material made exact determinations difficult. (Campbell-NWWA) W71-06942

JACKS SAVE DAY FOR TEXAS TUNNELER.

Construct Methods Equip, Vol 51, No 9, p 90-93, Sep 1969. 7 fig.

Descriptors: *Tunneling, *Tunnel construction, *Tunneling machines.

*Pipe jacking, *Reaming auger, Identifiers: Houston, Texas.

To tunnel and line three oversized utility conduits under a Houston street, the subcontractor resorted to pipe-jacking instead of machine-tunneling when crews were unable to hold the boring rig on the center-line. The subcontractor planned to use a rig that was custom-built for a Dallas storm-drain project. With the addition of a shield over the auger, the job was attempted in Houston's soft earth. After the centering trouble stopped work, the remaining tunnels were completed by mining with pneumatic shovels and jacking the liners into place with the subcontractor's designed equipment. W71-06973

8F. Concrete

WISCONSIN SANITARY SEWER WON BY 2.3%.

For primary bibliographic entry see Field 05G. W71-06545

Field 08—ENGINEERING WORKS

Group 8F-Concrete

CHICAGO SEWER DRAIN PROJECT. For primary bibliographic entry see Field 05G.

MICHIGAN SEWER AND ROAD JOB. For primary bibliographic entry see Field 05G.

STORM SEWER CHANNEL IN NEBRASKA. For primary bibliographic entry see Field 05G. W71-06548

HANDBOOK OF STEEL DRAINAGE AND HIGHWAY CONSTRUCTION: CHAPTER 1 -PRODUCT DETAILS.

For primary bibliographic entry see Field 08A. W71-06640

HANDBOOK OF STEEL DRAINAGE AND HIGHWAY CONSTRUCTION PRODUCTS: CHAPTER 3 - SERVICE LIFE. American Iron and Steel Inst., New York

Am Iron Steel Inst, New York, NY, p 64-81, 1967. 20 fig, 2 tab, 10 ref.

Descriptors: *Drainage systems, *Steel structures, *Economic feasibility, Inspection. Identifiers: Soil conditions, Water conditions.

This chapter confirms that corrugated steel drainage structures can be economically designed for either normal conditions or for highly corrosive industrial and sanitary sewers and for mining, salt water and other difficult service conditions. The first section deals with inspection methods and results, including parts on: destructive forces; methods of determining durability; laboratory tests; highway culvert inspections; sewer inspections, air force base drainage inspection; airport drainage; and levee culverts and sewers. Section II concerns the influence of various types of soil and water conditions, and Section III discusses design for service life, including topics such as: the amount of durability needed; service conditions; base metals; galvanized coatings and their service life; non-metallic coatings and linings; pavements in pipe; California service life determination; and miscellaneous products and conditions (subdrainage, steel end sections, steel retaining walls, liner plates, sheeting, and guardrail). (See also W71-06639) W71-06642

CRITERION OF CRACK RESISTANCE UNDER THERMAL STRESSES FOR A CONCRETE BLOCK RIGIDLY FASTENED IN THE FOUN-

Bureau of Reclamation, Denver, Colo.

V. D. Dubyago.

Available from NTIS as PB-193 610T, \$3.00 in paper copy, \$0.95 in microfiche. Translated from the Russian, Izvestiic Vsesoiuznoga Nauchno-Isseledovatel-Skogo Institute Gidro Tekhniki, Leningrad, Vol 76, p 305-331, 1964. Bureau of Reclamation Translation No 672, Denver, June 1969. 38 p,

Descriptors: *Cracks, *Thermal stress, *Concrete testing, Concrete technology, Foundations. Identifiers: *Concrete blocks, Crack control, Concrete aging.

A rationale is presented for selection of a criterion of crack resistance under thermal stresses. Methods of estimating crack resistance of a concrete block rigidly fastened in the foundation are considered, with account taken of its cooling regime, age of concrete at the moment of initial hardening, and the effect of the initial warming-up period. W71-06796

8H. Rapid Excavation

SYMPOSIUM ON SEA-LEVEL CANAL BIOEN-VIRONMENTAL STUDIES.

Battelle Memorial Inst., Columbus, Ohio. For primary bibliographic entry see Field 05B. W71-06714

RADIONUCLIDE PRODUCTION FOR THE NUCLEAR EXCAVATION OF AN ISTHMIAN

CANAL, Battelle Memorial Inst., Columbus, Ohio. For primary bibliographic entry see Field 05B. W71-06715

REDISTRIBUTION HYDROLOGIC RADIONUCLIDES AROUND A NUCLEAR-EX-CAVATED SEA-LEVEL CANAL, Isotopes, Inc., Palo Alto, Calif. For primary bibliographic entry see Field 05B.

SEEPAGE CHARACTERISTICS OF EXPLO-SIVELY PRODUCED CRATERS IN SOIL AND

ROCK, Army Engineer Nuclear Cratering Group, Liver-more, Calif.; and Army Engineer Waterways Ex-periment Station, Vicksburg, Miss. For primary bibliographic entry see Field 02G. W71-06781

BUREAU OF RECLAMATION EXPERIENCE IN USE OF BORING MACHINES IN TUNNEL EX-CAVATION,

Bureau of Reclamation, Denver, Colo.

B. P. Bellport.

W71-06718

Paper Fall Meet Society of Mining Engineers, St. Louis, Mo, Oct 1970. 61 p, 15 fig, 1 tab, 8 ref.

Descriptors: *Tunneling machines, *Tunnels, *Rapid excavation, Rocks, *Tunnel construction, Earth handling equipment, Rock excavation, Muck, Ventilation, Geology, Tunnel supports, Tunnel linings, History.

The experiences of the Bureau of Reclamation in the use of tunnel boring machines to excavate 6 major tunnels on water resources development projects are summarized. Case studies for each of the 6 tunnels, with data on tunnel dimensions, geological characteristics of the excavated rock, the tunneling machines used, machine operation, muck handling, method of tunnel support, ventilation system, and related information are presented. Despite the diversity of dimensions and the variety of rock encountered during excavation, the 6 tunnels have one major characteristic in common: excavation was significantly expedited by the use of boring machines. Boring machines make possible smoother walls and uniform diameter, and more importantly in the tunnel lining, considerably less concrete is required to maintain the specified uniform thickness than is required for the rough, irregular walls of a conventionally driven tunnel. One example cited was estimated to require 3-1/2 times more concrete for lining a conventionally excavated tunnel than was used for lining the bored tunnel. (USBR) W71-06834

LASER ALIGNMENT TECHNIQUES IN TUN-

A. Cooney

Proceedings American Society of Civil Engineers, Journal of the Surveying and Mapping Division, Vol 96, No SU2, p 229-243, Sept 1970. 15 p, 10 fig, 2 tab, 1 ref, 2 append.

Descriptors: Tunnels, *Tunneling machines, Tunnel construction, Bench marks, Curves, *Alinement, *Lasers, Mining, *Surveying instruments, *Surveying, Construction, Tunneling, Deflection, Gradients, *Control systems, Construction control. Identifiers: Targets.

With the introduction of the mechanical mining machine or 'mole', the role of the engineer has machine or 'mole', the role of the engineer has become one of providing a constant course of direction for the machine rather than establishing and projecting the tunneled path traversed by it. The primary tool in accomplishing this task is an alinement control system capable of providing guidance and detecting and distinguishing the components of motion generated by the mining machine. Consisting of a laser beam instrument, auxiliary control points along the tunnel, and a target system affixed to the machine, such a system provides a graphical guide to the machine operator. get system affixed to the machine, such a system provides a graphical guide to the machine operator. The mechanics of setting up such a system are outlined and various types of target systems are categorized. Techniques for adapting such a system to various alinement problems are proposed. (USBR) W71-06842

ADVISORY CONFERENCE ON TUNNELLING HELD IN WASHINGTON, D. C. ON 22-26 JUNE 1970: PROCEEDINGS.

Organization for Economic Co-Operation and Development, Paris (France). Directorate for Scientific Affairs.

Available from NTIS as PB-195 014, \$3.00 in paper copy, \$0.95 in microfiche. OECD Publ. DAS/CSI/T/70.76, Aug 1970. 203 p.

Descriptors: *Tunneling, *Excavation, *Tunnel construction, Rock mechanics, Soil mechanics, Rock excavation, Underwater.
Identifiers: Urban areas, *Soft ground tunneling, *Rock tunneling, *Immersed tunnel construction.

Included in the proceedings are all addresses, statements and reports presented at the plenary sessions, together with the recommendations of the Conference. (Working Documents also available -PB-193 286.) Proceedings cover reports on tunnelling demand, rock tunnelling, cut-and-Cover Construction, soft-ground tunnelling, immersed tunnel construction, research and development related to tunnelling, and Conference recommenda-tions. The appendix contains prepared comments of certain national delegations and official observers, as well as other items of general interest. W71-06926

BREAKTHROUGH ON SECOND MERSEY ROAD RUNNEL AS WORK COMMENCES ON DUPLICATE.

Civil Eng Public Works Rev, Vol 65, No 765, p 378, Apr 1970.

Descriptors: *Tunneling, *Tunneling machines, *Tunnel linings, *Linings, *Concretes, *Steel, *Epoxy resins, Construction equipment. Identifiers: *Great Britain, *Mole, *Mini Mole.

A mole tunneling machine was used to excavate through sandstone rock between Liverpool and Birkenhead. The tunnel was lined with a segmented type of lining made up of reinforced concrete acting compositely with an inner steel skin. It was then covered with a high-build epoxy protective coating. A duplication of the tunnel is to be built for which a Mini Mole has been designed for driving a 2,202yard pilot tunnel. A description of the Mini Mole is given. W71-06972

PIPELAYER MINIMIZES TRENCHING AND BACKFILLING.

Construct Methods Equip, Vol 51, No 8, p 42-45, Aug 1969.

Descriptors: *Tunneling, *Tunnel construction, *Tunneling machines, *Installation, Pipelines.

Identifiers: *Badger Minor, *Tugmaster, *Galveston, Texas.

The first domestic water system for the Gulf Coast resort area near Galveston is being installed with two trenchless pipelaying methods known as the 'pull through' and the 'slow in' techniques. Basically, both involve tunneling through the ground and pulling long strings of pipe through the bore with very little disturbance of the ground at the surface. The principal pieces of equipment used on this job are the Badger Minor and the Tugmaster. The functions of these pieces are described and the two methods of pipe installation are explained.

SEWER MOLE TRIMS COST OF TUNNEL RIBS AND CONCRETE.

Construct Methods Equip, Vol 48, No 5, p 93-95, May 1966.

Descriptors: *Tunneling, *Tunneling machines, Investigations, *Tunnel construction Identifiers: *Sewer tunnel, St. Louis, Missouri.

In a comparative study between the mechanical tunneling method and the drill-and-shoot method, five distinct advantages in mechanical boring were reported by Victor J. Scaravilli, a contractor on a St. Louis sewer tunnel. A description of the 23,000foot sewer tunnel which the S and M Constructors of Cleveland are boring for the Metropolitan St. Louis Sewer District is included. W71-06975

PAVED WAY FOR TRANSOONA'S LONG HOLE

Eng Contract Record, Vol 82, No 10, p 58-60, Oct 1969. 1 diag.

*Sewers, *Tunnels, *Tunneling, Descriptors: *Tunnel design, Planning, Construction.
Identifiers: *Storm sewer, Canada.

BACM Industries Ltd. in Winnipeg built the largest and longest sewer tunnel ever contracted Manitoba. This storm relief project is described in a brochure they mailed to all residents in the area. The basic construction plan involved the sinking of 10 shafts to a depth of 34 feet at regular intervals, the sewer being tunnelled outward from each shaft and connected to form one long tunnel. The softmining method was employed, and no problems were encountered except for the high water table created during spring because of flooding conditions above ground. This was overcome by boxing off the area and using sump pumps to divert the water until workers were finished in that area. Tunneling procedures used are discussed, including the open cut method employed for a portion of the storm relief sewer. W71-06976

THOMPSON RIVER MOLE BORE IS THE LON-GEST IN HARD ROCK.

Eng News-Record, Vol 183, No 5, p 18, Jul 31,

Descriptors: *Tunneling, *Tunneling machines, *Tunnel design, *Construction equipment, *Tun-

Identifiers: *Mole, *Australia.

A 12-mile tunnel, which will divert water from the Thompson River through 3,600-ft Mount Gregory to the Yarra River, is a 24 million dollar project. The project has three stages: (1) excavation of the Thompson and Yarra adits (totaling 3,260 feet); (2) excavation of the 1,390 foot Easton adit, and a 2.9 mile section of the main tunnel between the Easton and Thompson adits; and (3) boring of the 9.1 mile main tunnel using the mole. W71-06977

MOLE BREAKS THROUGH AFTER 293-FT. DAY AND 1,114-FT WEEK.

Eng News-Record, Vol 183, No 4, p 28-29, Jul 24,

Descriptors: *Bids, *Tunnel construction, *Tunneling machines, Tunnel design, Cost comparisons. Identifiers: *Mole.

The Utah Construction and Mining Co.'s mole boring machine, called Jarva Mark 11-1200, averaged 109 feet per day at an estimated \$15/ft. cutter cost. Remarks made by the project manager which encompass the operation of the mole and the construction design, are included. A cost comparison of the different contract bids is given. W71-06978

PIPES JACKED BEHIND MINI-MOLE.

Eng News-Record, Vol 182, No 20, p 45-46, May

Descriptors: *Sewers, *Cost comparisons, *Tunneling machines, *Tunneling. Identifiers: *Mini Mole, *Chicago, *Mole.

A mining machine, which jacks concrete pipe sections immediately behind it, is being used to build a sewer in suburban Chicago. The technique, commonly used to avoid cut-and-cover construction across highways and railroads, entails building a two mile sanitary sewer under a \$2.9 million contract. The procedure involved is explained, and a cost comparison study of mining and jacking the 66-inch diameter pipe into place, with a 78-inch-ID reinforced concrete sewer using conventional methods of machine mining, ribs, lagging and monolithically placed concrete, is given. W71-06979

MOLE BORES AT 16 FEET PER HOUR.

Eng News-Record, Vol 179, No 42, p 29, Oct 19,

Descriptors: *Drilling, *Drilling equipment, *Tunnel construction. Identifiers: *Mole, West Germany.

A mechanical mole excavating under West Germany's Swabian Jura range has a cutting head made up of four rotating steel-toothed cutting wheels mounted on a rotating base. On the vertical axis, the operator of the mole steers by raising or lowering the cutting head; and horizontally, the mole is steered with the aid of small crawler tracks. A laser control system keeps the mole on course. W71-06980

MODERN TUNNELING METHODS USED ON BOLTON SEWER.

Surveyor, Vol 85, No 4049, p 38, Jan 16, 1970. 1

Descriptors: *Tunneling, *Sewers, *Tunnel construction, *Tunnel design, *Tunneling machines. Identifiers: *Great Britain.

Fifteen years ago, a Radcliff sewer connection by tunnel was more expensive than a riverside route on the surface. However, developments in tunneling made it possible for a tunnel route to provide savings over the sewer's probable life. So, a 3/4mile long sewage tunnel was constructed. Blasting was used for the greater part of the length, and excavated materials were removed by means of an electrically-driven small gauge railway. Instead of employing compressed air for shaft sinking, a recently developed boring technique was used. The method is fully described along with other construction and installation procedures. W71-06982

RECENT TUNNEL EXCAVATION WITH BORING MACHINES,

D. E. Cannon. Civil Eng, Vol 37, No 8, p 45-48, Aug 1967. 3 tab.

Descriptors: *Tunneling machines, *Drilling, *Routing, *Rock excavation, *Tunneling. Identifiers: *Mole, *Machine comparison.

Mole boring machines are making tunnel excava-tion records on the U.S. Bureau of Reclamation's San-Chama Project for additional water supply routes to Rocky Mountain cities of north central New Mexico. A series of three tunnels are required for this project. Geology reports indicated that the rock to be encountered--shale and sandstone-could be economically excavated by a mole. Drilling was performed from the surface along the tunnel alignments at roughly one mile intervals. A main concern was whether igneous dikes or sills existed at tunnel elevation which might preclude using a boring machine. Results of the exploration program were encouraging and did not indicate presence of igneous intrusions. Advantages cited of boring machines over concentional tunneling methods include: higher excavation rate, reduction in concrete needs, fewer personnel requirements, safer operations, reduction in required supports and in clean-up time. Disadvantages of mole boring include: high initial investment; long delivery period; restriction to softer rocks; and the requirement for a well maintained ventilation system, an accurate guidance system, and expert surveying technicians. W71-06983

MECHANIZATION DRAINAGE WORK, **UNDERGROUND**

J. Dunglas.

Houille Blanch (HOBLAB), Vol 23, No 6, p 529-538, 1968.

Descriptors: Equipment, *Mole drainage, *Piping systems (Mechanical). Identifiers: *Deep drainage.

The advantages of mechanized pipe-laying equipment for deep drainage systems are reviewed and technical features of trenching machines with optical depth-setting and built-in pipe laying systems are described. The adaptation of drainage system design to allow for use of mole-plow type machines is examined. W71-06984

MOLE ANCHORS IN PILOT HOLE AND PULLS ITSELF AHEAD, Michael Kolbenschlag.

Construct Methods Equip, Vol 52, No 4, p 87-88, 90-91, 94-95, Apr 1970. 5 fig.

Descriptors: *Tunneling machines, *Drilling, *Tunnels, *Drill holes.
Identifiers: *Mole, *Mole structure, Laser beam.

Instead of advancing by having the cutterhead jacked against the face, as most tunneling machines do, a Detroit hydraulic rig used a reverse technique. This mole drilled a pilot hole in the center of the face, locked in place an anchor concentric with the pilot-drill stem, and then pulled itself forward hydraulically against resistance of the anchor. The main cutterhead and pilot drill advanced simultaneously. Water and fault zones complicated early stages of work on the water tunnel, but the contractor hoped to make up time with the new method. Complete descriptions are given of the structure of the machine, mucking operations, laser guidance, and the mole's power source. W71-06985

LASER BEAM ON MOLE SPEEDS SEWER WORK.

Alex Mair.

Eng Contract Record, Vol 83, No 2, p 44-45, Feb

Field 08—ENGINEERING WORKS

Group 8H-Rapid Excavation

*Tunneling *Instrumentation, Descriptors: machines, Tunneling, Operations.
Identifiers: *Mole, *Laser beam control.

A tunnel in Edmonton is being produced at an average of 120 ft/day. A tunnel mole and the use of a laser beam have hastened the procedure. The practical limit on the distance the beam can travel depends on two things: changes in direction of the line, and the amount of dust and fog in the air in the tunnel. The mole consists of a set of rotating arms with cutting teeth and a bucket wheel for catching the loosened material. The workings of the tunnel operation are given. W71-06986

HYDRAULIC DESIGN OF UNLINED ROCK

TUNNELS, Skrikrishna V. Chitale, K. S. Rajagopalan, and

David Ellis Wright.

J Hydraulics Div, Am Soc Civil Engrs, Vol 96, No HY4, p 1060-1065, Apr 1970. 1 fig, 3 ref.

Descriptors: *Rock properties, Hydraulic design, Roughness (Hydraulic). Identifiers: *Unlined tunnels.

S.V. Chitale and K.S. Rajagopalan comment on Figures 2 and 3 of the original article. Fig. 2 shows a plot of resistance coefficients for unlined rock tunnels, and considerable scatter of data is apparent. The authors list reasons for this scatter. Fig. 3 gives tunnel overbreak for various tunnel sizes. The authors note the difficulty involved in using this figure to estimate overbreak depth because of the presence of considerable scatter, and they suggest a way to improve this situation. David Ellis Wright notes that progress will be made in desig-ning unlined rock tunnels only if a critical comparison is made of results on prototype tunnels. He lists requirements to be satisfied in order that these results be of wider design use. He also defines terms such as tunnel size, overbreak, relative roughness, and equivalent sand grain diameter, which he uses in his commentary on the original paper. His comments include opinions on the resistance equation, the relation between resistance and roughness, partly-lined conduits, and data in Table 2 of the original paper. W71-06987

8I. Fisheries Engineering

THE INFLUENCE OF ENGINEERING DESIGN AND OPERATION AND OTHER ENVIRON-MENTAL FACTORS ON RESERVOIR FISHERY RESOURCES,

Bureau of Sport Fisheries and Wildlife, Fayet-

Robert M. Jenkins.
Water Resources Bulletin, Vol 6, No 1, p 110-119,
January-February 1970. 10 p, 1 fig, 5 tab, 4 ref.

Descriptors: *Reservoir fisheries, *Water quality, *Environmental effects, structural characteristics.

Design, Hydrologic aspects, Water chemistry, Fish
Design, Unissolved solids, Water *Environmental effects, Structural engineering, management, Ecology, Dissolved solids, temperature, Sampling, Methodology, temperature, procedures, Evaluation, Fish repro Aquatic environment, Reservoir operation. Fish reproduction,

The effect of selected reservoir environmental variables--including surface area, mean depth, outlet depth, thermocline depth, water level fluctuation, storage ratio, shore development, total dissolved solids, growing season and age of reservoir--on fish standing crop in 140 large impoundments has been explored through partial correlation and multiple regression analyses. The sample was partitioned into 25 subsamples based on reservoir use type, water exchange rate, thermocline formation and water chemistry. Fish standing crops were estimated by summer rotenone sampling of coves or open water areas enclosed by blockoff net. Logarithmic partial correlation revealed highly significant (0.01 confidence level) positive effects of outlet depth, shore development and dissolved

solids on total standing crop in the entire sample. At the 0.20 confidence level, the crop of all sport fishes is positively influenced by outlet depth, storage ratio and shore development and negatively by mean depth. A morphoedaphic expression, total dissolved solids divided by mean depth, provides a useful index to reservoir fish production. The relationship is curvilinear, with maximum crops expected at index values of 5 to 30. The index accounts for 62 percent of the variability in hydropower storage reservoir crops. (Woodard-USGS) W71-06496

09. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

NATIONAL INSTITUTE OF ECOLOGY--AN OPERATIONAL PLAN. Ecological Society of America.

December 1970. 42 p, 4 fig, 3 tab.

Descriptors: *Research facilities, *Project planning, *Organizations, *Institutions, Ecology, Social needs, Environment, Balance of nature, Biology, Financing, Planning, Federal budgets, Estimated costs, Programs, Professional societies, Technical societies, Frograms, Frograms, Frograms, Tolessional societies, Technical societies, Facilities, Laboratories, Model studies, Analysis, Management, Research and development, Administration, Education, Social aspects, Political aspects.

The Ecological Society of America presents herein an organizational plan for a National Institute of Ecology. This proposed organization is designed to assemble multidisciplinary groups from existing ecological and scientific talents to work on major ecological and related questions. The Institute will perform five types of functions: (1) basic ecologi-cal research beyond the capacity of existing agen-cies; (2) conduct selected short-term projects in response to specific requests; (3) economic and social analysis focusing on environmental and resource management policy; (4) services to working ecologists, including analytical and modeling services, taxonomic support, and field facilities and installations; and (5) communication and educa-tion. The Institute will have a director appointed by a nine-member board of trustees elected for threeyear overlapping terms. Trustees will be chosen by the Founding Institutions and an open Assembly representative of corporate groups and individuals. There will be a staff of forty persons which will increase to 150. Federal funding will be sought for the laboratory, equipment, and for BIOME modeling and synthesis. Federal and private funds will be nig and synthesis. Federal and private funds will be sought for policy research, communication, and education. Costs of forecasting and planning will be met by contracting agencies. (Robinson-Florida) W71-06619

NOTES ON SEDIMENTATION ACTIVITIES, CALENDAR YEAR 1969.
Bureau of Reclamation, Washington, D.C

For primary bibliographic entry see Field 02J. W71-06720

9D. Grants, Contracts, and **Research Act Allotments**

WATER RESOURCES RESEARCH ACTIVITIES AND INTERESTS AT THE UNIVERSITY OF CONNECTICUT,

Connecticut Univ., Storrs. Inst. of Water

William C. Kennard, and Jane S. Fisher. Available from NTIS as PB-198 344, \$3.00 in paper copy, \$0.95 in microfiche. Connecticut University Institute of Water Resources Report No 12, September 1970, 55 p. OWRR Project A-999-CONN (7).

Descriptors: *Water resources research act, *Connecticut, *Universities, Manpower, Training, Grants, Research and development.
Identifiers: *University of Connecticut.

Two principal functions of the University of Connecticut Water Resources Institute are to sponsor and coordinate research and to increase opportuni-ties for the interdisciplinary approach both to research and graduate training. This publication was prepared to show staff interests in the broad was prepared to show stall interests in the oldade field of water resources. The information provided in this publication is based on responses to a questionnaire sent in February 1970 to all staff members of the University. The respondents represented 32 different departments or equivalent administrative units of the University. The information obtained was listed in the following categories: faculty conducting and/or interested in water resources research; faculty conducting water water resources research; faculty interested in but not currently conducting water resources research; summary of water resources research interests; summary of current water resources research; and summary of water resources research proposed or desired. (Knapp-USGS) W71-06656

ABSTRACTS OF PUBLICATIONS REPORTING RESULTS OF RESEARCH,
North Dakota Water Resources Research Inst.,

Fargo; and North Dakota Univ., Grand Forks. Gary W. Paulson.

Gary W. Paulson. Available from National Technical Information Service as PB-198 426, \$3.00 in paper copy, \$0.95 in microfiche. North Dakota Water Resources Research Institute Report WI-110-001-71FCST: X-C, February 1971. 54 p. OWRR Project A-999-N Dak (1).

Descriptors: *Abstracts, *Water resources research act, *North Dakota, *Universities, Contracts, Grants, Bibliographies, Publications, Research and development, Water resources development, Groundwater, Surface waters, Seepage, Water quality, Erosion, Water conserva-tion, Lakes, Water pollution effects. Identifiers: *North Dakota State University, *U-

niversity of North Dakota.

Abstracts are presented of publications reporting results of research on water problems to indicate what research has been completed in North Dakota, the objectives of the research, and the results and application of the research. These abstracts are intended to provide a reference source to research reports available from the North Dakota Water Resources Research Institute. Complete reports of all research described in this publication can be obtained by making inquiry to: Dr. Dale O. Anderson, Director, Water Resources Research Institute, North Dakota State University, Fargo, North Dakota 58102. The abstracts are organized alphabetically by problem areas. The problem areas are consistent with the water resources research categories established by the Federal Council for Science and Technology. (Knapp-USGS) W71-07051

10. SCIENTIFIC AND **TECHNICAL INFORMATION**

PHREATOPHYTES - A BIBLIOGRAPHY.

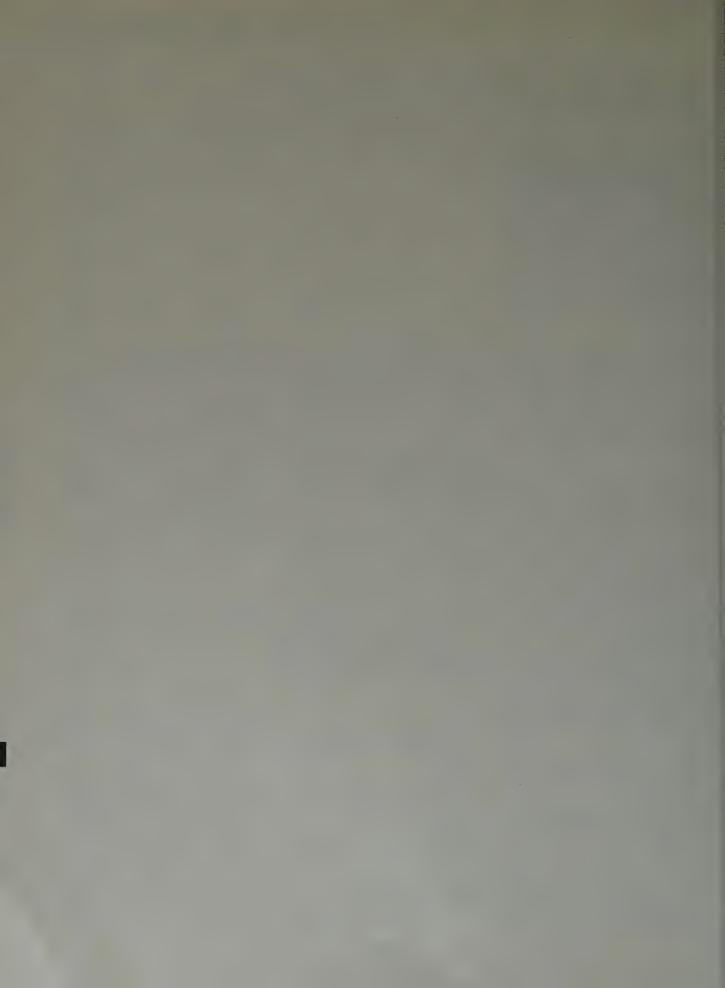
Water Resources Scientific Information Center, Washington, D.C. For primary bibliographic entry see Field 03B. W71-06596

ANNOTATED BIBLIOGRAPHY ON SNOW AND ICE PROBLEMS.

Toronto Univ., Ontario, Canada. Dept. of Geog-For primary bibliographic entry see Field 02C. W71-06719

URBAN ECONOMICS AND PLANNING, VOLUME I, A DDC BIBLIOGRAPHY.
Defense Documentation Center, Alexandria, Va. For primary bibliographic entry see Field 04C.
W71-06777

ABSTRACTS OF PUBLICATIONS REPORTING RESULTS OF RESEARCH,
North Dakota Water Resources Research Inst.,
Fargo; and North Dakota Univ., Grand Forks.
For primary bibliographic entry see Field 09D.
W71-07051



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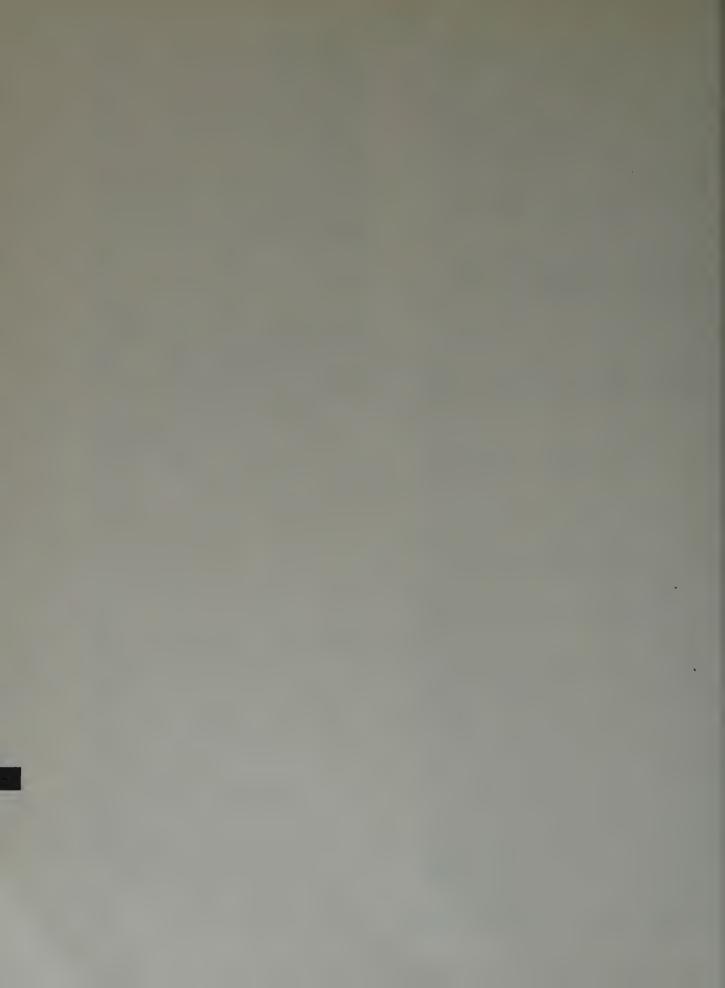
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Alaska Institute of Water Resources	W71-07057	1
Indiana Water Resources Center	W71-06933	1
C. Others		
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Maryland Natural Resources Institute	W71-06595	1
Environmental Protection Agency	W71-07052	1
American Society of Civil Engineers	W71-07053	1

CENTERS OF COMPETENCE AND THEIR SUBJECT COVERAGE

- Ground and surface water hydrology at the Water Resources Division of the U. S. Geological Survey, U. S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the EPA-Water Quality Office, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.
- Water well construction technology at the National Water Well Association.

Supported by the Environmental Protection Agency in cooperation with WRSIC.

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.
- Agricultural livestock wastes at the Department of Agricultural Engineering of Iowa State University.
- Methods for chemical and biological identification and measurement of pollutants at the Analytical Quality Control Laboratory of the Water Quality Office of the Environmental Protection Agency.
- Coastal pollution at the Oceanic Research Institute.

Subject Fields

- NATURE OF WATER
- WATER CYCLE
- WATER SUPPLY AUGMENTATION AND CONSERVATION
- WATER QUANTITY MANAGEMENT AND CONTROL
- WATER QUALITY MANAGEMENT AND PROTECTION
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